Pottery
MADE EASY

POTTERY MADE EASY

The Potter.

Upon the potter's flying wheel the clay
Knows not the purpose of its plasmic day.

James B. Kenyon, The Potter's Clay.

Pottery MADE EASY

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PREFACE

This book is the result of fifteen years of work and experimentation with instructional material in ceramics in the industrial-arts department of Oakwood High School, in Oakwood, a suburb of Dayton, Ohio. It comprises instruction sheets on pottery, intended for junior- or senior-high-school levels, which conform to modern educational principles, and are so systematized and simplified as to be suitable either in the classroom or for the self-instruction of the more mature who wish to become acquainted with this fascinating craft.

Pottery is becoming more popular every year, both as a hobby and as a unit in the industrial-arts program. This growth finds justification in many ways. Being perhaps the oldest of the arts, pottery has played and continues to play a very important part in our everyday life. Its interests are broad and varied. It includes the historical, the ethnographic, the artistic, and the technical. In it are combined the skills of the craftsman, the artist, and the scientist, for the true potter must possess deft hands, know design, and be something of a chemist, a geologist, and a physicist.

It has been said that pottery records the touch and the feeling of the worker better than can be done in most other crafts, and that it carries art into the common things of life, combining the useful with the beautiful. It is an activity in which art and skill are everything — the material nothing. It is a craft in which creative work can be made most enduring. It widens the viewpoint of the student, and allows him to explore further into the field of industrial activity. It affords interesting opportunities for art training in several wholly different types of decoration, and provides a leisure-time hobby of absorbing interest.

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POTTERY MADE EASY

CHAPTER I

POTTERY—AN INTERESTING CRAFT

Many lovers of craftwork who would like to try their hand at this interesting craft have not done so because their unfamiliarity with it has led them to believe a high degree of ability and expensive equipment are necessary to produce satisfactory results. The author wishes to correct this mistaken idea and show that the craft of pottery provides interests for all ages and all degrees of skill, and that it can be undertaken at an expense that is no greater than that required by other popular crafts. While the student may go as far as his interests and his ability, or his resources, will take him, there is a wide field of opportunity in clay modeling, and in hand- or even wheel-built ware, where the inexperienced can produce pieces of interest and worth at very little expense for material or equipment.

Let us consider some of the beginner's problems and see how they can be successfully solved. Let us tackle the most frequently asked question at the outset, the question of the kiln. The problem of firing has always been one of mystery to the uninitiated, and has probably

Fig. 1. A camp pottery.

Fig. 2. A, an outdoor kiln similar to the one described in Chapter XI; B, stoking the kiln with wood; C, unpacking the kiln.

prevented more craft lovers from enjoying the thrills of pottery making than any other. Yet, this problem can be solved in several ways. Where funds are available, the new electric kilns of low current consumption which have recently been put on the market in a wide range of sizes are ideal; or the portable muffle kilns fired with gas; or, where this fuel is not available, with kerosene. These kilns give, in the order named, the most in cleanliness, ease of control, and certainty of results. However, if a manufactured kiln is out of the question, and where outdoor space is available, great experience and fun can be had building a kiln, such as the one shown in Figure 2, which uses wood or coal as fuel. These kilns can be built with a few cents' worth of old discarded bricks, and will be found to give surprisingly good results. A detailed description of a kiln, like the one shown in Figure 2, is given in Chapter XI. If *firebrick* can be purchased, more extensive and permanent updraft or downdraft kilns can be built without great expense.

For those who can neither buy nor build, there are still two ways to solve the problem. Most potteries will fire pieces made by the amateur, at a reasonable charge. Unfired pottery, if carefully packed, can be sent long distances. If this service is not available, the student can still produce good pottery by using specially treated clays that are now on the market which require only the heat of the kitchen oven to harden. While this clay does not produce ware equal in durability to the kiln-glazed ware, it is an excellent medium for beginners or schools that would like to give the craft a tryout before investing in firing equipment.

Let us see what other equipment and materials may be needed and

how they may be obtained. Making tiles, modeling small figures, and building vases and other objects with coils or slabs require no further equipment that cannot be picked up around the home, camp, or school. Old buckets, tin cans, earthenware jars for storage and mixing, a small board or piece of linoleum to work on, small sticks for the tile mold, cardboard, scissors, and pencil for making templates or patterns will all be found useful. Native clay may often be used successfully, and the search for it, especially at camps and in the country districts can be made the occasion of exciting excursions, which, if successful, add materially to one's sense of achievement. The ready-ground clay, however, is inexpensive, and can be obtained at any pottery or pottery supply house, or from dealers in craft supplies.

Casting and pressing clay objects in molds, and the making of the molds themselves have always been fascinating processes. Children especially delight in opening molds, and look with anxious eyes to see if their piece is a success. Regular pottery molds are made of plaster of paris. To make these, one needs only a sack of common plaster of paris, a few pieces of scrap boards from old boxes when making square molds, or pieces of scrap linoleum or cardboard when making round ones, some twine or *stovepipe* wire, and a can or jar in which to mix the plaster.

Molds for small pieces, particularly modeled figures with undercuts that would require a plaster mold of several parts, may be made of the new flexible materials now available, and the cast made in plaster or other quick-setting material (Chapter VI). With molds, even a

Fig. 3. A pottery area in a school shop.

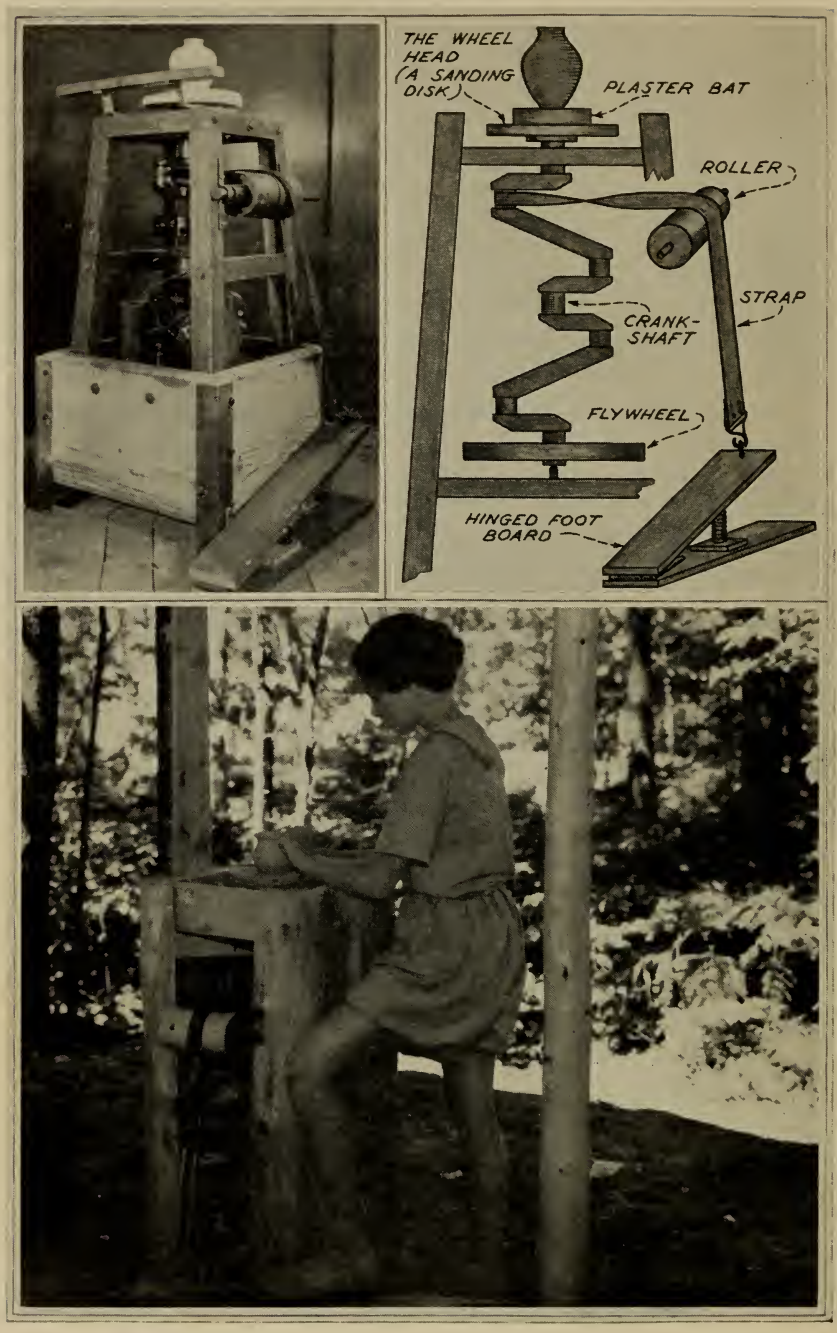

Fig. 4. A potter's wheel made from an automobile crankshaft and flywheel.

small child can make successful pottery in its first attempt. For this reason, casting is an excellent method for camps or large elementary classes where the child has insufficient time to acquire the degree of skill necessary for success in other methods.

Fig. 5. Motor-driven potter's wheel made from discarded washing machine. Note gauge sticks.

The spinning up of vases, bowls, lamp bases, candlesticks, ash trays, etc., on the potter's wheel is the most interesting phase of the craft, and to those with sufficient patience to acquire a degree of skill as a *thrower,* as the worker at the wheel is called, it becomes an absorbingly fascinating pastime. The potter's wheel is a very simple piece of equipment. Low-priced wheels, run either by foot or electric power — the cheaper ones clamp on any worktable — are on the market today, or anyone handy with tools can make his own. An old automobile crankshaft and flywheel mounted vertically makes an excellent foot-power wheel (see Fig. 4). The power is transmitted from a hinged footboard or treadle by a strap which runs up over a roller and across to one of the connecting-rod bearings on the crankshaft as shown in Figure 4.

A motor-driven wheel can be made from an old electric washing machine by fitting a sanding disk horizontally on the vertical shaft which turned the wringer. The wringer and tub are, of course, dis-

pensed with, though the tub can be used as a small clay bin, and only the motor, the shortened shaft, the reduction gearing connecting them, and perhaps the frame are used (see Figs. 5 and 6).

For the more mechanically minded, and for those who wish to make many similar pieces as in tea sets and flatware, the method known as *jiggering* will open up another interesting phase of this fascinating craft. The commercial jiggers and jolleys intended for heavy production are rather expensive, but jigger attachments to some of the factory-made wheels are obtainable at a moderate cost. Many successful jigger attachments, of the type shown in Figure 106, have been made for the potter's wheel in school shops and by mechanically inclined amateurs.

Fig. 6. A portable potter's wheel using the reduction gear and motor from a discarded washing machine.

Many other homemade contrivances and substitutes will occur to the alert craftsman. Turning or shaving tools, for instance, can be made from strips of heavy sheet metal, ¼ to 1 in. wide and 6 in. long, bent at right angles ¾ in. from one end, and sharpened. The turning stick, which supports the arm when a clay piece is shaved on the wheel, is only a broomstick with a tenpenny nail driven in the end and sharpened to a point (Fig. 102). A tin insect spray gun will spray glazes nicely, and so on.

There are few other crafts that offer as wide a range of interesting activities. The example of one enterprising group of boys and girls is typical. They found and dug their own clays, made their own designs and patterns, cast their molds, built their wheel and kiln, and cut and hauled their own firewood. They worked at the wheel and the mold and stoked their kiln in full view of the highway, and many curious tourists stopped to admire, and stayed to buy their interesting pieces.

A list of all tools, equipment, supplies, and materials necessary to perform the operations described in the following pages, with information concerning their use, is incorporated in the index (see p. 175).

CHAPTER II

POTTERY AND ITS HISTORY

The word *pottery* is from the Latin *poterium,* meaning *drinking vessel.* In its widest sense, it is applied to all objects formed of clay and hardened by heat. In its more restricted sense, the term is applied only to common earthenware or crockery, and sometimes to crockery and to the finer grades of earthenware together. It is in this last sense that we use the term in this book. Practically all amateur or school pottery is earthenware.

Commercial pottery may be roughly divided into three classes — earthenware, stoneware, and porcelain. These divisions are not well marked, there being an almost imperceptible gradation from one to the other. The chief characteristics of each class are as follows:

a) *Earthenware:* The *body* is dull and opaque, porous, adheres to the tongue, absorbs liquids, and is sufficiently soft to be scratched with a knife. It is fired at comparatively low heats. It is usually

Fig. 9. A corner in a commercial pottery.

covered with a colored glaze which may be either transparent or opaque. The glaze renders the earthenware impervious to liquids and increases its durability and beauty.

b) *Stoneware:* The *body* is hard, dense, opaque, vitreous, cannot be scratched with a knife, is impervious to moisture, and does not cling to the tongue. It is fired at a high heat. The best grades might be classed as inferior porcelain.

Fig. 10. From wall painting in tomb of Khnumhotep at Beni Hassan. Dyn. XII (about 2000 B.C.). Illustrating use of potter's wheel in Ancient Egypt. At the right, a man shapes a pot with his right hand while his left keeps it turning on the potter's wheel. At the left is an oven on which pots are baked. Above are shown the pots already completed.

c) *Porcelain:* The characteristics of stoneware may also be applied to porcelain except that the porcelain body is translucent and semi-fused. It is still more vitreous, containing a larger proportion of glassy matter, and is fired at the highest heat used in pottery.

In examining and comparing broken pieces of earthenware with pieces of stoneware and porcelain, it will be noticed that the glaze on the earthenware appears to be entirely distinct from the *body,* while the glaze on the stoneware and porcelain seems to be incorporated with the body.

Pottery is an ancient craft, due to the universal necessity for utensils for domestic use, the ease of obtaining the needed materials, and the few tools needed in this primitive industry. It seems to have been known to all primitive peoples all over the world. The earliest pottery was built up by hand, without the aid of either wheel or mold, and was fired at comparatively low heats without glaze in the open fire or in crude ovens. It was often beautifully decorated, as can be seen in the collections of early American Indian pottery in our

Fig. 11. Prehistoric bowls from Pueblo Bonito. Black-on-white ware.

museums. Some remarkable examples have been found in Peru and Central America.

At the dawn of history, pottery had reached advanced stages among the civilized peoples of China, Egypt, Persia, and Mesopotamia, where glazed and enameled ware, beautiful in shape and decoration, was being made on the wheel and in the mold. From these centers, this knowledge seems to have spread to Phoenicia, Greece, and the Mediterranean, to Arabia and India, and to Korea, Siam, and Japan. The best known of the later ancient pottery, famous for the chaste simplicity and beauty of form and decoration, are the red Greek vases, covered with a thin polished black varnish, which were made several centuries before the Christian era. The black smoked ware and the light red Samian or Arretine ware of the Romans (200 B.C. to A.D. 300) also are noteworthy. The industry spread to northern Europe and Britain with the conquests of Rome, but with the coming of the Dark Ages, it was all but forgotten, and pottery in Europe reverted to the primitive art of the barbarians.

When the Moors swept across northern Africa and conquered Spain in the eighth century, they brought into Europe a knowledge of enamels and lusters that the Arabs, who were good chemists, had perfected. In Spain were found plentiful supplies of tin, so necessary in making the white opaque glaze with which the Moors covered the coarse ugly body of their ware. Decorations in highly colored enamels and lusters were applied on top of this white glaze. This was the foundation from which developed the famous majolica pottery of the Italian cities of the fifteenth and sixteenth centuries. The most outstanding work of this period was done by Luca della Robbia, a Florentine sculptor. His metallic lusters have hardly been equaled. The manufacture of tin glazed *faience,* as glazed earthenware then came to be known, spread from Italy to northern Europe, and many

places in France, Germany, Holland, England, and Spain became famous for the wares which they produced.

The famous Henri Deux ware, highly prized for its scarcity and remarkable workmanship, was made at the Chateau d'Oiron in France about 1550. It was made of a cream-colored clay decorated with inlays of darker colored clays and glazed with a clear lead glaze. The romantic story of Bernard Palissy's desperate struggles at this time to perfect his enamels is of great interest to any student of the subject. His naturalistic pieces were tinted with colored glazes, and while he produced excellent and beautiful wares, he never achieved his lifelong dream of perfecting a white glaze having the appearance of porcelain. Since 1508, the Portuguese and the Dutch had been importing the beautiful white translucent porcelain from China, which, though expensive at first, became cheap enough to threaten the existence of the faience industry as the taste and demand for the oriental product developed. Imitations, such as the blue and white delftware, were for a time popular, and a frantic search for the secret of true porcelain began.

The Chinese, the world's greatest potters, whose best work is unrivaled in both color and form, claim to have made porcelain as far back as 200 B.C., but many authorities doubt if true porcelain was made before the fourteenth century. At least our earliest specimens date from the Ming Dynasty (1368–1644). The greatest and most prolific period in Chinese ceramics, however, occurred during the

Fig. 12. Egyptian predynastic jar, decorated with gazelles and ostriches.

Fig. 13. Greek. Amphora. Mycenean. 1200 B.C.

reign of K'ang Hsi (1662–1722). Japan was making porcelain in the sixteenth century. Her wares were especially noted for their tasteful decoration.

The search for the secret of porcelain led to the discovery of *soft* porcelain made of various artificially compounded pastes. Finally, in 1706, the German chemist Boettiger stumbled onto the true white porcelain clay, kaolin, while examining some dusting powder which his barber had used on his wig. In a few years the porcelain industry was flourishing at Dresden, but the secret was soon out and the knowledge spread over Europe. The wares of Sevres and Limoges in France, and Copenhagen are also famous. In England, Josiah Spode perfected the English bone china which greatly stimulated the industry in that country. Very fine stoneware was also being made at this time, especially in Germany and in England. The cream-colored lead glazed English "Queensware" and the beautifully ornamented "Jasperware" of Josiah Wedgwood (1730–1795) became world famous. Wedgwood himself probably did more to advance the pottery industry than any other man. His great factories in Staffordshire were models of mechanical perfection, the result of his great organizing and inventive genius.

Fig. 14. Tzu Chon ware. Chinese. Sung dynasty. A.D. 960–1280.

One of the first attempts in making pottery in America was in Burlington, New Jersey, as early as 1685, though very little progress was made for nearly a century and a half, due to the competition of the superior wares of the older English potteries. Other early potteries were started in the colonies, in 1760 in Massachusetts, in 1765 in South Carolina, and in 1769 in Philadelphia, but it was not until well toward the middle of the next century that the industry was firmly established.

The more important potteries of this later period were located in the New Jersey district, which was destined to become one of the great pottery centers of the United States. One, established in Jersey City in 1825, produced ware superior to any made up to that time in Amer-

ica. About the same time, another, in Philadelphia, operated by William Tucker, began to produce a full line of ware of excellent quality. Soon after 1850 several potteries were established in Trenton. By 1880, this city was producing one fourth of the ware made in the United States.

One of the first potteries west of the Alleghenies was established in 1836 at Troy, Indiana, by Mr. Clewes, an English manufacturer. In 1839 a superior pottery clay was discovered near East Liverpool, Ohio, and before many years a large number of factories were flourishing in the district. By the end of the century, eastern Ohio, with its plentiful supplies of clays and natural gas, had become another great pottery center. In the past fifty years great advances have been made in the science of all branches of the industry and in manufacturing methods. There has also been a revival of fine earthenware pottery in both this country and in Europe, and wares of great artistic merit have been produced.

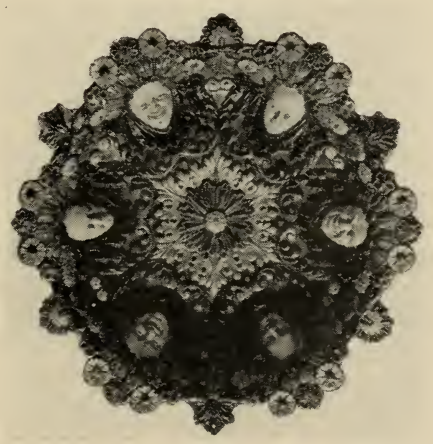

Fig. 15. French Faience. Bernard Palissy. 1510–1590.

CHAPTER III

THE TECHNIQUE OF POTTERY MAKING

In making almost any craft article the beginner soon perceives that instead of doing just one big job, he has really done a series of little jobs or operations. In making a different article in the same craft he sees that some of the different jobs he did in making the first article are repeated. After he has made many articles he finds he has mastered all the little jobs or operations of the craft and now, to make additional articles, he only needs to decide which of these operations are necessary and the best order in which to perform them.

As this is especially true with pottery, the author has divided the craft into thirty-five operations, the directions for which are logically

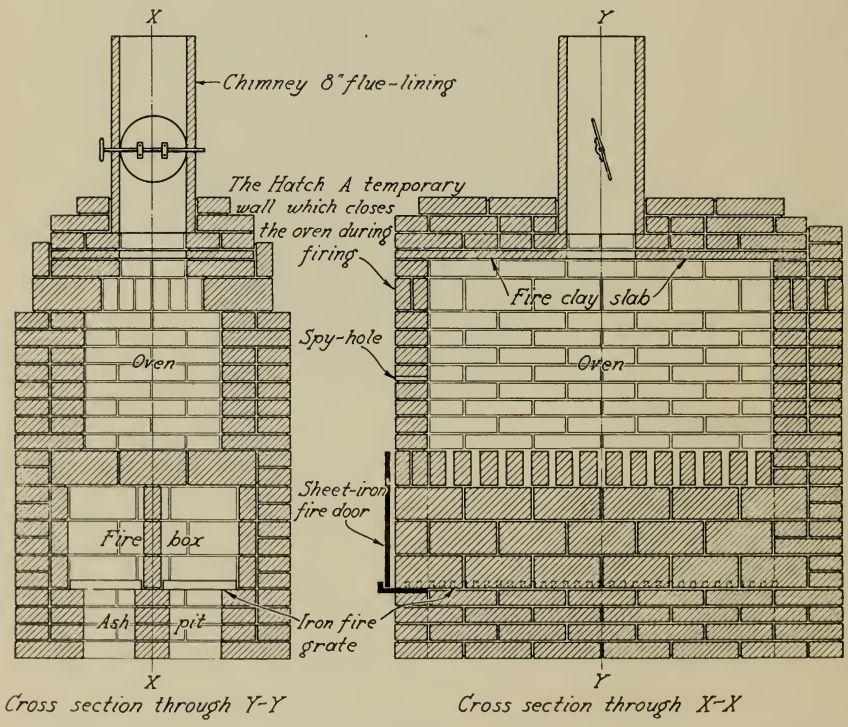

Fig. 16. A small updraft kiln using coal, coke, or wood. The ware is placed in saggers (see Fig. 124) which are stacked in the oven.

PROJECT CHART Suggested Things to Make	1 Pressing a tile	2 Building with coils	3 Sticking up with slabs	4 Modeling figures	5 Slip casting	6 Pressing with slabs	7 Pressing small figures	8 Pressing flatware	9 Making plaster casts	10 Throwing on the wheel	11 Jiggering flatware	12 Jiggering hollow ware
Ash tray		X	X		X			X		X	X	
Box			X			X						
Bowl		X	X		X	X				X		X
Candlestick		X	X		X					X		
Coaster		X			X			X		X	X	
Cream pitcher		X	X		X					X		
Cup		X			X					X		X
Dish (irregular)			X		X							
Dish (shallow)		X			X			X		X	X	
Figure (modeled)				X	X		X		X			
Flowerpot		X	X		X	X				X		X
Flower box			X			X						
Jar		X	X		X	X				X		
Jardiniere						X						
Jug		X	X		X	X				X		X
Lamp base		X	X		X	X				X		
Mosaic	X											
Plate								X		X	X	
Pitcher		X	X		X	X				X		
Salt shaker			X	X	X							
Saucer		X			X			X		X	X	
Sugar bowl		X	X		X					X		
Teapot		X	X		X					X		
Tile	X						X		X			
Tray			X									
Vase		X	X		X	X				X		X

Table I. Project Chart. This chart, under the heading SUGGESTED THINGS TO MAKE, lists typical pieces and indicates the several methods that may be used to make them in the craft shop.

grouped in the following eight chapters. How to apply these directions to the making of all kinds of craft pottery is shown in the twelve project outlines which follow in this chapter. Each of these project outlines lists in order all the possible steps or operations that must be taken to make the article. The detailed directions for doing each step are given in the operations indicated. As the decorating, glazing, and firing operations are the same for all the pottery projects described, they are not repeated for each project, but given separately on page 22, and can be referred to when the last step in each outline is reached. The operation which forms the piece is called the *key* operation and is printed in italics.

To begin work, the student should first consult the project chart (Table I) which shows the methods used in making 26 different articles of pottery. He may then decide upon which article in the suggested list he wants to make, and then choose one of the possible

methods to use in making it, as indicated by X in the project-outline columns opposite the name of the article. If, however, he is interested in using a particular method, he must confine his choice to one of the suggested articles opposite an X in the chosen column.

Before a beginner can choose a method intelligently, he must, of course, familiarize himself with the equipment and materials of the shop, and gain an understanding of the methods by reading the directions for performing the operations. These should never be read indiscriminately or consecutively, but a project outline always should be followed. In this way the directions become constructive and meaningful.

Having decided upon what to make and the outline to follow, the student has only to follow the steps in order, as directed. He should be governed, of course, by the following obvious considerations:

1. Omit steps already prepared, as for example, if the clay has been mixed, or if an existing design, template, mold, pattern or profile are to be used.

2. Omit steps to be performed by another person, as for example, if the firing or possibly the glazing is to be done by another.

3. Omit steps not called for in the design, as for example, if no decoration is wanted or if no handles or other appendages are needed.

PROJECT PROCEDURE OUTLINES

Project 1: To Make a Tile

Procedure Steps		Refer to Operation
1	Mix the clay	1, p. 26
2	Wedge the clay	2, p. 28
3	Roll out a clay slab	3, p. 30
4	*Form the tile**	4, p. 32
5	Decorate, glaze, and fire	31 to 35, p. 22

Project 2: Building with Coils

Choice of projects: Vase, bowl, flowerpot, lamp base, teapot, pitcher, or ash tray.

Procedure Steps		Refer to Operation
1	Design the piece	5, p. 35
2	Make the template	6, p. 42
3	Mix the clay	1, p. 26
4	Wedge the clay	2, p. 28
5	*Build the piece with coils of clay*	7, p. 43
6	Make by hand or model the handles, spout, feet, and other appendages and ornaments if the design calls for any	9, p. 48
7	Attach the appendages	10, p. 54
8	Decorate, glaze, and fire	31 to 35, p. 22

Project 3: To *Stick Up* a Vase, Using the Slab Method

Choice of other projects: Bowl, flowerpot, box, lamp base, teapot, pitcher, tray, flower box, or ash tray.

Procedure Steps		Refer to Operation
1	Design the piece	5, p. 35
2	Mix the clay	1, p. 26
3	Wedge the clay	2, p. 28
4	Roll out a clay slab	3, p. 30
5	*Cut and stick up the slabs*	8, p. 46
6	Model the handles, other appendages and ornaments if the design calls for any	9, p. 48
7	Attach the appendages	10, p. 54
8	Decorate, glaze, and fire	31 to 35, p. 22

*Key operations in all of these outlines are shown in italics.

Project 4: To Model a Figure in Relief or in the Round

Choice of projects: An animal, a flower, a head, or a design.

Procedure Steps		Refer to Operation
1	Mix the clay	1, p. 26
2	Wedge the clay	2, p. 28
3	*Model the figure* (If the figure is not suited to firing, its likeness can be preserved by casting a copy in plaster in a flexible mold, a plaster piece mold, or a waste mold, Project 9)	11, p. 55
4	Decorate, glaze, and fire	31 to 35, p. 22

Project 5: To Slip Cast a Vase

Choice of other projects: Bowl, flowerpot, lamp base, teapot, pitcher, jug, candlestick, or figure.

(If a mold already on hand is used, begin with step 8.)

Procedure Steps		Refer to Operation
1	Design the piece	5, p. 35
2	Make a template if the piece is round	6, p. 42
3	Make some soap size and read the directions for applying it	12, p. 65
4	Read the directions for mixing and pouring plaster	13, p. 66
5	Make a pattern of clay by the coil or slab method, on the potter's wheel, or by modeling	7, p. 43 8, p. 46 11, p. 55 26, p. 111 or 27, p. 127
	Or turn a plaster pattern	14, p. 69
	Or use a piece of fired pottery of glassware for a pattern, using, of course, no design or template	
6	Make the type slip mold best suited to the pattern	15, p. 75
7	Make appendage molds if the design calls for appendages	16*a*, p. 83
8	Mix the clay slip	1, p. 26
9	*Slip cast the piece*	19, p. 95
10	Model or press the appendages and ornaments if the design calls for any	9, p. 48 11, p. 55 or 21, p. 99
11	Smooth up mold marks	23, p. 102
12	Attach the appendages or ornaments	10, p. 54
13	Decorate, glaze, and fire	31 to 35, p. 22

Project 6: To Press a Vase, Using Clay Slabs

Choice of other projects: Flowerpot, jardiniere, or other hollow ware or a figure.

Procedure Steps		*Refer to Operation*
1	Make the mold for the body (and for the appendages, if any) in the same manner as outlined in the previous Project (No. 5, Steps 1 to 8) or use a mold already on hand.	
2	Mix the clay	1, p. 26
3	Wedge the clay	2, p. 28
4	Roll out a clay slab	3, p. 30
5	*Press or mold the piece*	20, p. 97
6	Model or press the appendages and ornaments, if the design calls for any	9, p. 48 11, p. 55 or 21, p. 99
7	Smooth up the mold lines and other defects	23, p. 102
8	Attach the appendages and ornaments	10, p. 54
9	Decorate, glaze, and fire	31 to 35, p. 22

Project 7: To Press a Small Modeled Figure in a Press Mold

(If a mold already on hand is used, begin with step 5.)

Procedure Steps		*Refer to Operation*
1	Model the figure	11, p. 55
2	Make some soap size and read the directions for applying it	12, p. 65
3	Read the directions for mixing and pouring plaster	13, p. 66
4	Make the press mold	16, p. 83
5	Mix the clay	1, p. 26
6	Wedge the clay	2, p. 28
7	*Press the figure*	21, p. 99
8	Smooth up the mold lines and other defects	23, p. 102
9	Decorate, glaze, and fire	31 to 35, p. 22

Project 8: To Press a Plate on a Press Mold

Choice of other projects: Saucer, ash tray, shallow dish, or other flatware.

(If a mold already on hand is used, begin with step 5.)

Procedure Steps		*Refer to Operation*
1	Design and make a pattern of clay by the coil or slab method, or on the potter's wheel	7, p. 43 8, p. 46 26, p. 111 or 27, p. 127
	Or use a finished piece for the pattern	
2	Make some soap size and read the directions for applying it	12, p. 65
3	Read the directions for mixing and pouring plaster	13, p. 66
4	Make the hand mold for pressing the flatware	16*c*, p. 84
5	Mix the clay	1, p. 26
6	Wedge the clay	2, p. 28
7	Roll out a clay slab	3, p. 30
8	*Press the piece*	22, p. 100
9	Smooth up the mold marks	23, p. 102
10	Decorate, glaze, and fire	31 to 35, p. 22

Project 9: To Make a Plaster Cast of a Figure

Procedure Steps		*Refer to Operation*
1	Model the figure to be used as a pattern as outlined in Project 4, or use a figure already on hand as a pattern	
2	Make (*a*) a flexible mold	18, p. 93
	or (*b*) a plaster figure mold	17, p. 85
3	*Make the plaster cast*	24, p. 103

Project 10: To *Throw* or Spin Up a Vase on the Potter's Wheel

Choice of other projects: Bowl, flowerpot, candlestick, lamp base, jug, teapot, pitcher, jar, or ash tray.

Procedure Steps		*Refer to Operation*
1	Design the piece	5, p. 35
2	Make the template	6, p. 42
3	Make some soap size and read the directions for applying it	12, p. 65
4	Read the directions for mixing and pouring plaster	13, p. 66
5	Cast a plaster wheel bat	25, p. 109
6	Mix the clay	1, p. 26
7	Wedge the clay	2, p. 28
8	*Throw or spin up the piece on the wheel*	26, p. 111
9	Model or press the appendages and ornaments if the design calls for any	9, p. 48 11, p. 55 or 21, p. 99
10	Turn or shave the top, sides, or base of the piece if necessary	27, p. 127
11	Attach the appendages and ornaments	10, p. 54
12	Decorate, glaze, and fire	31 to 35, p. 22

Project 11: To *Jigger* a Plate on a Jigger, or a Potter's Wheel with a Jiggering Attachment

Choice of other projects: Saucer, ash tray, caster, a shallow dish, or other flatware.

(If a mold and profile already on hand are used, begin with step 6.)

Procedure Steps		*Refer to Operation*
1	Design the piece	5, p. 35
2	Make the profiles	28, p. 133
3	Make some soap size and read the directions for applying it	12, p. 65
4	Read the directions for mixing and pouring plaster	13, p. 66
5	Make the jigger mold	29, p. 137
6	Mix the clay	1, p. 26
7	Wedge the clay	2, p. 28
8	Roll out a clay slab	3, p. 30
9	*Make the piece on the revolving mold*	30, p. 139

10	Model or press appendages and ornaments if the design calls for any	9, p. 48 11, p. 55 or 21, p. 99
11	Attach the appendages and ornaments	10, p. 54
12	Decorate, glaze, and fire	31 to 35, p. 22

Project 12: To Make a Bowl on a Jigger or Jolley, or a Potter's Wheel with a Jiggering Attachment

Choice of other projects: Cup, flowerpot, a wide-mouthed vase, or other hollow ware.

To make hollow ware in a revolving mold, follow the outline for Project 11, except that step 8, calling for Operation 3, is omitted as a clay slab is not used.

To Decorate, Glaze, and Fire Pottery

Procedure Steps		*Refer to Operation*
1	Tool or model the clay surface if desired	31, p. 143
2	Pack the ware in the kiln for the first or biscuit firing	33*a*, p. 158
3	Place the pyrometric cones in position	34, p. 161
4	Fire the kiln for the biscuit firing	35, p. 164
5	Decorate the biscuit with colors if desired	31, p. 143
6	Apply the glaze	32, p. 150
7	Pack the biscuit ware in the kiln for the glost firing	33*b*, p. 159
8	Fire the kiln for the glost firing	35, p. 164

Chapter		OPERATIONS	1 Pressing tiles	2 Building with coils	3 Sticking up with slabs	4 Modeling figures	5 Slip casting	6 Pressing with slabs	7 Pressing small figures	8 Pressing flatware	9 Making plaster casts	10 Throwing on the wheel	11 Jiggering flatware	12 Jiggering hollow ware
IV Preparing Clay	1	Mixing clay	1	3	2	1	8	8	5	5	1	6	6	6
	2	Wedging clay	2	4	3	2		9	6	6	2	7	7	7
	3	Rolling out clay slabs	3		4			10		7			8	
V Handwork in Clay	4	FORMING TILES	4**											
	5	Designing pottery		1	1		1	1				1	1	1
	6	Making templates		2			2	2				2		
	7	BUILDING WITH COILS		5**										
	8	STICKING UP WITH SLABS			5**									
	9	Modeling appendages		6	6			12*				9*		
	10	Attaching appendages and ornaments		7	7		12	14				11	11	10
	11	MODELING FIGURES				3**			1		3			
VI Making Hand Molds	12	Sizing					3	3	2	2		3	3	3
	13	Mixing and pouring plaster					4	4	3	3		4	4	4
	14	Making plaster patterns					5*	5*						
	15	Making slip molds					6	6						
	16	Making press molds					7	7	4	4				
	17	Making waste molds									4			
	18	Making flexible molds									4			
VII Casting and Pressing	19	SLIP CASTING					9**							
	20	PRESSING HOLLOW WARE WITH SLABS						11**						
	21	PRESSING SMALL FIGURES, APPENDAGES					10		7**				10*	9*
	22	PRESSING FLATWARE								8**				
	23	Finishing cast and pressed ware					11	13	8	9				
	24	MAKING PLASTER CASTS									5**			
VIII Wheel Work	25	Casting a wheel bat										5		
	26	THROWING ON THE POTTER'S WHEEL								1*		8**		
	27	Turning or shaving										10		
IX Jiggering	28	Making profiles											2	2
	29	Making jigger molds											5	5
	30	PRESSING JIGGER WARE											9**	8**
X Decorating & Glazing	31	Decorating (green ware)	5	8	8	4	13	15	9	10		12	12	11
	31	Decorating (biscuit)	9	12	12	8	17	19	13	14		16	16	15
	32	Applying glazes	10	13	13	9	18	20	14	15		17	17	16
XI The Kiln and Its Operation	33	Packing kiln for biscuit firing	6	9	9	5	14	16	10	11		13	13	12
	33	Packing kiln for glost firing	11	14	14	10	19	21	15	16		18	18	17
	34	Using pyrometric cones	7	10	10	6	15	17	11	12		14	14	13
	35	Firing kiln for biscuit firing	8	11	11	7	16	18	12	13		15	15	14
	35	Firing kiln for glost firing	12	15	15	11	20	22	16	17		19	19	18

Key operations are shown in capitals

*Usual method
(For alternative see Project Chart)
**Key operations

Table II. Operation Sequence Chart. A comparison of the use of pottery operations in the foregoing Project Outlines. The chart may be used in place of the Project Outlines to determine which operations to perform.

CHAPTER IV

CLAY AND ITS PREPARATION

Clay is the chief material used in the pottery industry. It is found in all parts of the earth, and its composition varies widely. Clays range in color from white through yellow, gray, green, red, and from blue to black. These various shades are caused by impurities such as organic matter, iron oxides, and the like. Only those kinds which can be made plastic and will partially vitrify in the fire are used in making pottery. Clay is thought to be formed by the decomposition of feldspar contained in granite and other igneous rocks, the decomposition being caused by the action of water under great heat and pressure. When clays are found in association with the rocks from which they have been formed, they are called *primary* clays, while those which have been removed from their place of formation by rivers and glacial action, are known as *secondary* clays. Secondary clays contain more impurities, but are much more plastic and workable than primary clays, probably due to the prolonged grinding action to which they have been subjected while moving from one place to another.

Clay never has been found in a perfectly pure state, being more or less mixed with impurities such as small stones, sand, silt or rock dust, vegetable matter, and other nonplastic materials, which contain soda, potash, magnesia, lime, iron oxides, and the like. Chemical analysis shows that a perfectly pure clay is composed of alumina, silica, and water in the proportion of one molecule of alumina, two molecules of silica, and two molecules of water, which may be represented by the chemical formula Al_2O_3, $2SiO_2$, $2H_2O$, or, more simplified, $H_4Al_2Si_2O_9$. In other words, it is a hydrous silicate of alumina, composed approximately of alumina 40 per cent, silica 47 per cent, and water 13 per cent. The nearest to this found in nature is the fairly pure natural clay *kaolin* used in making porcelain. Other clays, such as ball clay, China clay, pipe clay, *potter's clay,* fire clay, etc., contain the same elements in different proportions, mixed with various amounts of impurities.

When dry, clay is very hard, but when moist it becomes plastic; that is, it yields under pressure, and does not return to its original form when pressure is removed. Its plasticity can be increased by adding more water until it becomes too soft to retain its shape. Coarse

clays and those containing much sand, as well as some of the primary clays, have little plasticity, and are known as being *short,* while some of the very fine clays are very plastic, or *long.*

The vitrification of a clay depends upon its fusing or melting point. This can be changed by altering the ingredients. Some clays are refractory, or infusible, meaning that they will not melt in a potter's kiln, the extreme heat of which seldom gets above 3000 deg. F. Others are very fusible. This difference is caused by two factors: First, the more alumina there is in a clay, other things being equal, the more refractory it is; second, it may contain certain impurities such as alkalies, soda, potash, or oxides, which act as a flux. A flux is a substance, not necessarily fusible in itself, which, when combined with an infusible substance, causes it to become fusible. In other words, the presence of the flux lowers the melting point. For example, if lime is mixed with an infusible clay, it fuses readily, though lime itself is infusible or refractory. A pottery clay needs not only to withstand the fire, but to have a binding quality to impart toughness to the ware. The Chinese spoke of *the bone and the flesh* of their porcelain, having reference to the clays from which it was made, the short refractory *kaolin* as the skeleton or framework to support the feldspar clay which bound it together.

Operation 1

MIXING CLAY

Low-firing clays can be purchased from almost any pottery or craft supply house, already ground, washed, and pugged or mixed by machinery. Often a satisfactory clay can be found in a neighboring creek bank or hillside and can be mixed as follows:

1. Break the clay up into small pieces and allow it to dry thoroughly.

2. Powder the dry clay. It can be put in a burlap sack or a strong wooden box and pounded with a heavy mallet.

3. Sift the powdered clay through a ⅛-in. mesh sieve.

4. Fill an earthenware jar or other suitable container half full of clean water.

5. Sprinkle the sifted clay into the water, handful by handful, until a small mound of the clay rises to the surface.

6. Let it soak one hour or more.

7. Plunge the bare arm into the jar, and stir the mass thoroughly and vigorously, making a mixture called *slip*.

8. If the clay mixture or slip feels sandy or *short* (not plastic enough), let it stand a few minutes for the sand to settle; pour it off into another jar, throwing the sediment away. If it still feels too sandy, repeat the operation. The *feel* of clay can only be learned by experience.

9. If the clay does not feel sandy enough, in other words, if it is too *rich, fat,* or *long* (too plastic, or too sticky), add a little fine sand, and mix thoroughly.

10. Pour the slip through a fine sieve into a jar or barrel.

11. Let the slip stand overnight.

12. Siphon off the clear water which has formed on top.

13. Repeat steps 11 and 12 until the slip is of proper creamy thickness for casting. Good casting slip for medium-sized ware weighs 27 ounces to the pint. Large pieces require thicker slip. Run it through a fine sieve before using.

A little sal soda or waterglass added to the water used in making slip improves it for casting because an alkaline water will dissolve and retain in suspension more clay than neutral or acid water. This

lessens the shrinkage as less water is required. Casting slip, as well as plastic clay, improves with age, as the particles more finely dissolve.

14. For modeling, building, or *throwing* on the potter's wheel, continue steps 11 and 12 until the clay is plastic enough to *wedge* (Operation 2), or about like fresh putty. It should be soft but not too sticky. Small amounts may be stiffened more quickly in plaster drying pans. These may be made in the same manner as the plaster tile mold explained at (*a*) in Operation 16, but of larger size.

Damp clay will soon dry out and become unworkable if the moisture has a chance to evaporate. This can be prevented in several ways. Small amounts of clay will keep soft if wrapped first in wet cloths and then with oilcloth or rubber sheeting, or if placed in a can or jar with a tight-fitting lid. Larger quantities are kept more conveniently in wood, metal, or earthenware storage bins. A common form is a zinc-lined wooden box provided with a low platform elevating the clay 2 or 3 in. above the bottom which is kept covered with 1 in. of water. The ends of cloths covering the clay should extend into the water. This keeps them wet by capillary action. An excellent damp box is made by casting a 2-in. lining of plaster slabs about the inside of a wooden box. If this lining is wet occasionally, and the lid closed, the clay will keep moist indefinitely.

Unfinished work can also be kept soft with wet cloths or in storage bins as described above.

Moist clay that has become too stiff can be made more plastic in the following manner. Push holes down into the clay with a stiff wire or rod within an inch or so of the bottom. Fill the holes with water and let stand for a few days. Broken or discarded pieces of dry unfired clay should be put in a waste bin to be powdered and used again.

Operation 2

WEDGING CLAY

Clay intended for hand building, modeling, or *throwing* on the wheel must be rid of air bubbles and made smooth and homogeneous throughout by *wedging* and *slapping*.

1. Take a portion of wet clay of the proper consistency (about like fresh putty) and large enough to perform the work intended, and form a ball.

2. Throw the clay ball on the clay table in such a manner that it will be cut in two parts by a taut wire which is stretched about 8 in. above the table (see Fig. 19). If a small amount is being wedged, the ball may be held with both hands and pushed down over the wire so that it will be cut in two parts.

Fig. 19. Wedging a small ball of clay.

3. Take the pieces of clay, one in each hand, and slam them forcibly together. If a large amount of clay is being wedged, allow one piece to remain on the table, using both hands to throw the other down upon it.

4. Repeat steps 2 and 3 a number of times, fifty or more if necessary, until the cut section of the clay appears to be of very even and uniform texture. Insufficiently wedged clay causes many failures for the careless beginner.

5. If the clay is too dry, sprinkle a little water on it or on the table under the wire, and repeat steps 2 and 3 until the clay is of uniform moisture.

6. If the clay is too wet, throw it on a slab of plaster placed under the cutting wire until sufficient moisture is absorbed by the bat.

Operation 3

ROLLING OUT CLAY SLABS

Clay slabs are used in making tiles, *sticking up* shapes, pressing hollow ware, and in making plates, saucers, and shallow dishes on the jigger.

1. Upon a flat surface, stretch and lightly tack at the corners a piece of smooth, closely woven cloth a few inches wider and longer than the desired slab.

Fig. 20. Rolling out a clay slab.

2. Get two straight sticks of wood about ¾ in. wide and 18 in. long. They should be as thick as you wish the clay slab to be, usually ¼ to ¾ in.

3. Lightly nail the strips at each end, parallel to each other on the cloth, as far apart as you wish the width of the clay slab to be. This should not be more than about 10 or 12 in. for best results.

4. With the hands or batter, press and pound soft, well-wedged clay (Operation 2) on the cloth between the strips, filling the space a little more than the thickness of the strips.

5. Roll the clay with a rolling pin until both ends of the pin roll on the wood strips, as shown in Figure 20.

6. Run a knife along the inside edges of the strips.

7. Remove the strips.

8. Pull the tacks at the corners of the cloth.

9. If the slab is too soft to handle properly, allow it to toughen before using.

CHAPTER V

HANDWORK IN CLAY

Operation 4 (Project 1, p. 17)

FORMING TILES

1. Make a wood form by nailing four strips 1 in. wide to a plane surfaced board, forming a square. The simplest method is to butt one end of each strip against the side of the adjoining strip as shown in Figure 23. The strips should be from ⅜ to ¾ in. thick depending on the thickness of the tile to be made. Placing a piece of oil cloth on the board before nailing on the strips will prevent possible warping of the board.

Fig. 23. Pressing a tile.

2. Dust the form with French chalk or very finely sifted clay dust to prevent the wet clay from sticking to it.

3. Roll out a clay slab as described in Operation 3 about ⅛ in. thicker than the desired tile, using thoroughly wedged stiff clay. Guard against having the clay too moist or the tile will crack due to unequal shrinkage. Shrinkage is lessened by mixing with the clay about a

fourth part of fine grog dust made by pounding up and sifting broken pieces of *biscuit* or unglazed pottery.

4. Cut a piece from the slab that will fit easily in the form.

5. Turn the piece over and press it firmly in the form. Roll it with the rolling pin, working from the center toward the edges. Scrape off the surplus clay with a straight stick or cut it with a fine wire stretched on a coping-saw frame. Roll the clay again, carefully, working from the center outward.

6. The surface of the tile may be made smooth with a dampened finger, or sprinkled with fine *grog* dust which will give a sandy finish.

7. When nearly *leather-hard,* run a knife around the edge of the tile, and carefully turn it out on a smooth surface, base up.

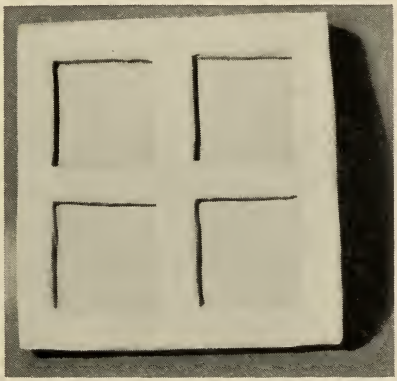

Fig. 24. Method of treating a tile base.

8. Leaving a ½-in. margin, mark out four areas on the base, ½ in. apart as shown in Figure 24. Lower the areas about one fourth the thickness of the tile as shown. If the face of the tile is to be decorated by incising, as in Figure 115, or by inlaying, this should be done, of course, while it is still plastic (see Operation 31).

9. Place the tile in the damp box or a cool place to dry very slowly and evenly to avoid warping and cracking. Dampen the edges if they dry faster than the center. This step applies to the drying of all clay pieces.

10. If the face of a plain tile becomes uneven or warped in drying, place it face down on the table on a sheet of fine sandpaper, and rub

lightly with a circular motion. Smooth out any fine scratches with a dampened finger.

If a number of duplicate tiles are wanted, a plaster mold or form described in part (*a*) of Operation 16 may be cast about the original. If the original is rectangular in shape, it is made in the adjustable wooden form described above. If a tile of special shape is desired, it may be cut from a rectangular slab. In all clay work, remember to allow about one eighth of the volume for shrinkage in drying and firing.

Mosaics can be made with small pieces, usually from ½ to ¾ in. square, cut from a thin slab of clay. The pieces can be made of different colored clays or glazed with different colored glazes. After firing they can be imbedded in cement to form table tops, house numbers, and the like.

Operation 5

DESIGNING POTTERY

The careful designing of a project is essential to successful results. Only the artist-potter of long experience can form a definite mental image of a well-proportioned design and then reproduce it in clay.

1. Decide what service the intended project is to perform. Always keep in mind that the outline, the proportion, the surface, and the color of a piece of pottery should be in keeping with the service that is expected of it. For example: A vase for tall, long-stemmed flowers, a pansy bowl, a child's oatmeal dish, a lamp base, or an ash tray, should all be designed with their ultimate use as a starting point.

2. With service in mind, and disregarding minor details, such as ornaments, handles, etc., decide how high and how wide the shape should be. Sketch a rectangle representing this width and height. This is known as the primary mass. If the width is greater than the height, it is known as a horizontal mass. If the height is greater than the width, it is known as a vertical mass.

3. Before attempting to sketch in the general outline, consider the rectangle in relation to the following rule, and modify it to conform to the rule: The relation of the width to the height should be such that it cannot be readily determined or analyzed by the eye. In other words, easily recognizable ratios should be avoided, such as 1 to 1, 2 to 1, or ratios closely approaching these, such as 1 to 1⅛ or 1 to

Fig. 25. Vase shapes.

Fig. 26. Vase shapes.

2⅛, etc. Examples of good proportions are: 2 to 5, 3 to 5, 3 to 8, 5 to 8, 7 to 10, etc. This rule cannot hold, of course, where technical requirements must be fulfilled, for example, where a square tile is required.

4. After the proportions of the primary mass have been decided upon, the next step is to sketch in the outline of the intended shape. Remember here as well as in decorating that "the secret of charm is simplicity." Before doing any sketching, carefully study the lines of the pottery shown in Figures 25 and 26 and the contours in Figures

26a, b, c, and *d.* If your outline is to be a simple curve, either the base or the top should be dominant. Remember that here, as elsewhere, the service to which the project is to be put must be considered. If more variety is desired in the curve, it may turn in at the top or at the base. A line drawn horizontally through this turning point should divide the primary mass into two parts, one of which should be clearly dominant. The ratio of the two parts should follow the rule of good proportion discussed in step 3. If further variety of outline is desired, a compound curve may be introduced. Horizontal lines drawn through the two turning points in the compound curve should divide the primary mass into three parts, the middle of which should be dominant, with the upper and lower parts varying in width.

5. These principles apply not only to handmade pottery but to that made by other methods as well, with this precaution: If the shape is to be cast, pressed, or jiggered, be sure, when drawing the design, that there are no *returns* that would prevent any part of the mold from separating or *pulling* from the shape when it is ready to be removed.

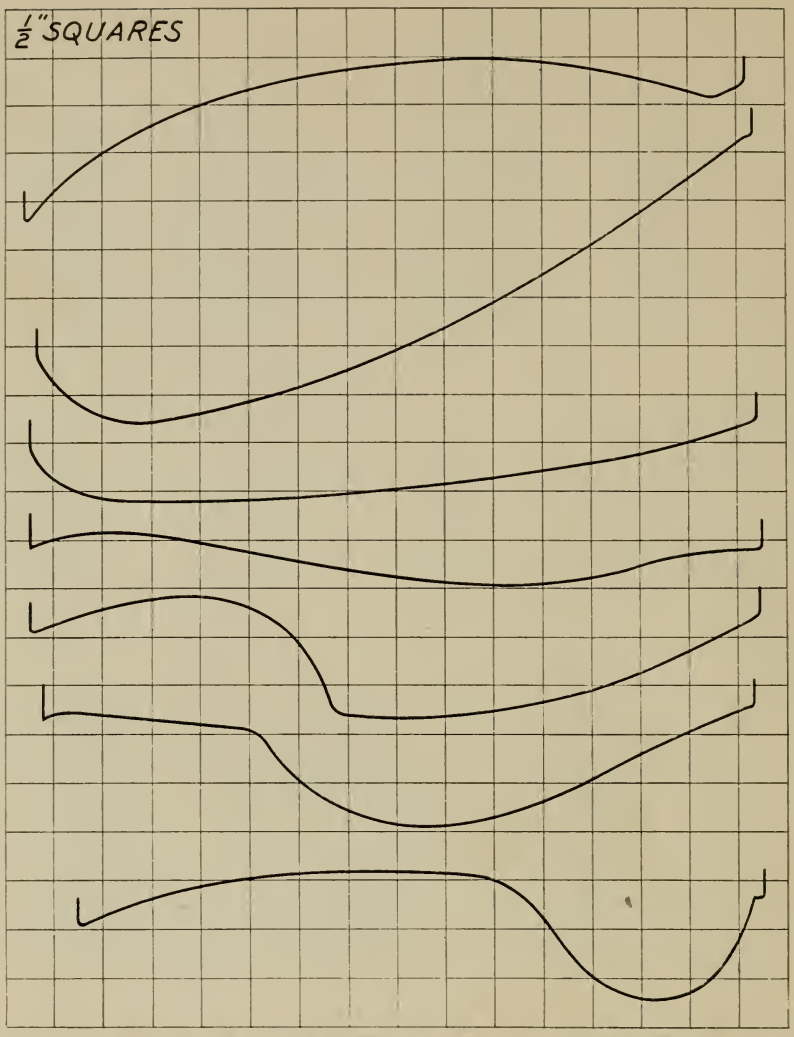

Fig. 26a. Typical contours for vases.

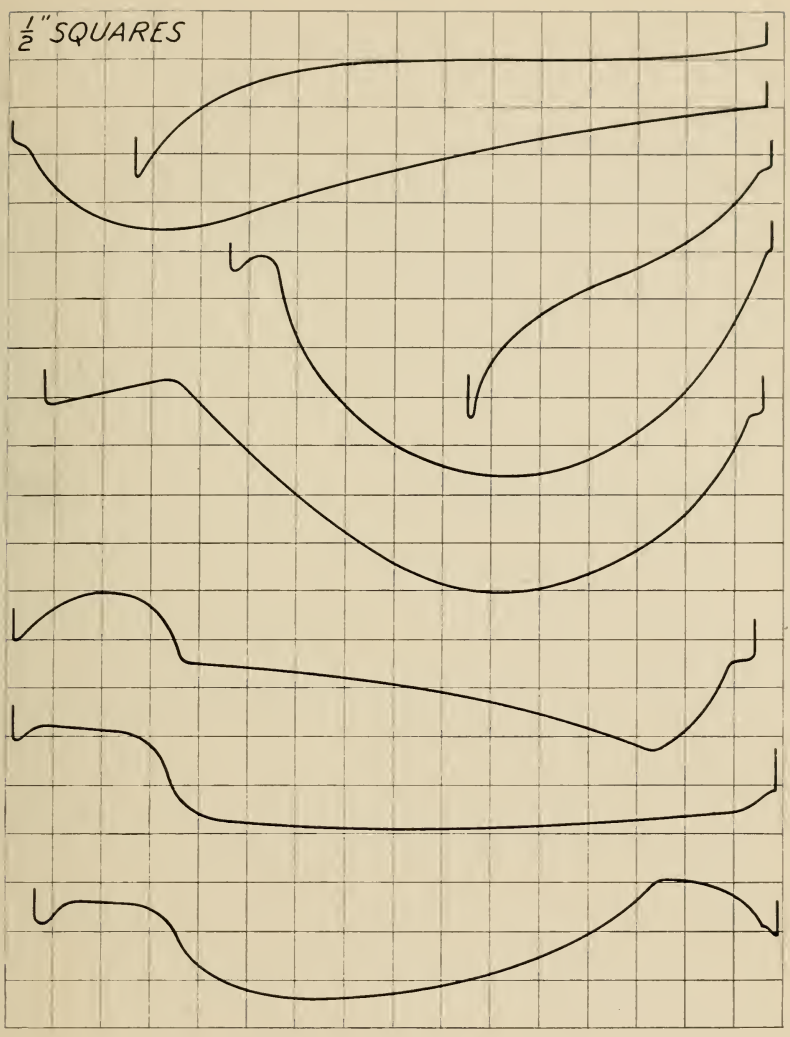

Fig. 26b. Typical contours for vases.

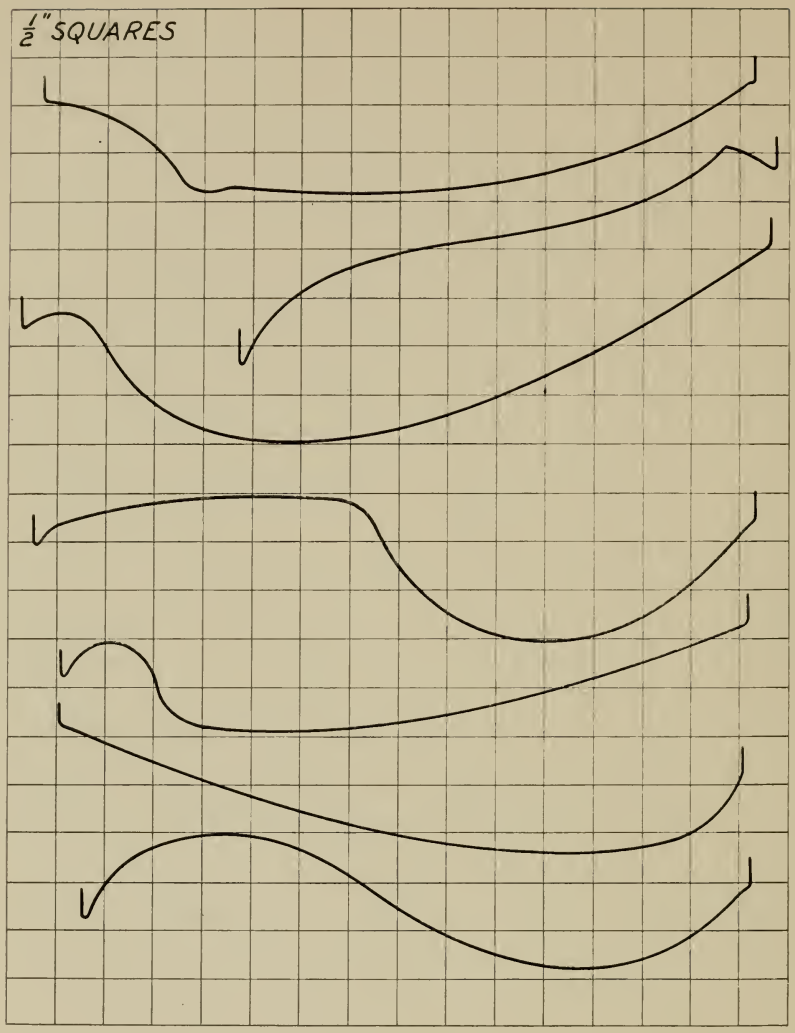

Fig. 26c. Typical contours for vases.

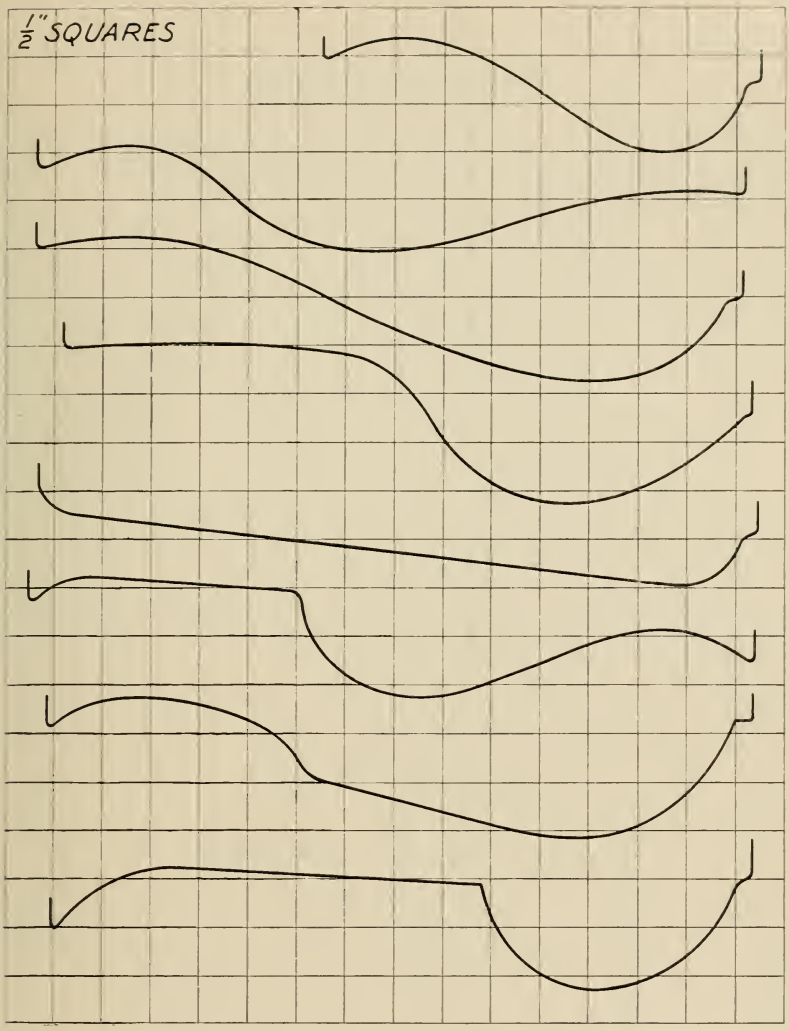

Fig. 26d. Typical contours for vases.

Operation 6

MAKING TEMPLATES

Carefully designed templates always should be used to guide the amateur when working at the wheel, building pieces by hand, or when turning patterns.

1. Design (discussed in Operation 5) and draw the outline or profile of the desired shape on a piece of cardboard, as shown in Figure 27. One side, that is, one half only need be retained. Make the drawing about one eighth larger than the desired finished product, on account of the shrinkage of the clay in drying and firing.

2. Cut along the outline, retaining the cardboard on the outside of it.

3. Cut the cardboard along a horizontal line at the top and along another horizontal line at the bottom of the outline, so that it may be used as a template or pattern to be held against the outside of the shape from time to time as the work progresses.

4. Make a note on the template at the top and bottom, indicating the desired diameters of the piece at these points, allowing for shrinkage as in step 1.

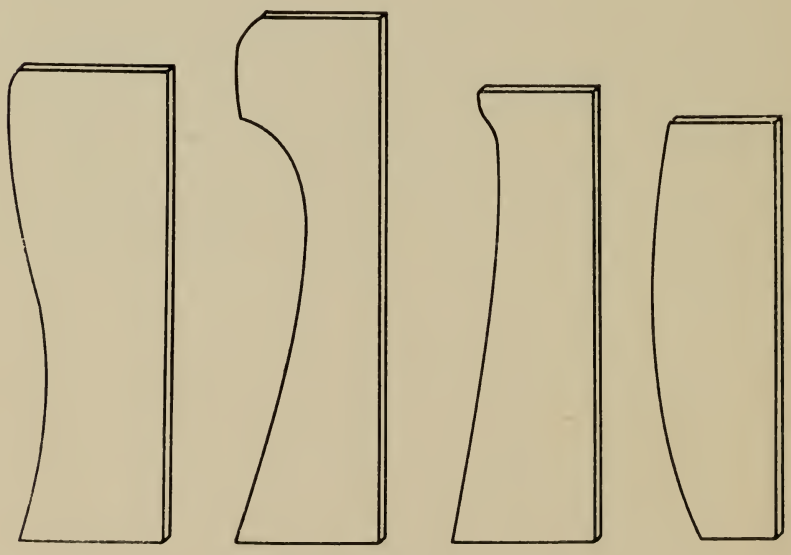

Fig. 27. Cardboard templates for vases.

Operation 7 (Project 2, p. 17)

BUILDING WITH COILS

a) Hand Building

Making pottery with coils of clay rope, as shown in Figure 28, was a method commonly used by the American Indian, and by many other primitive peoples.

1. Design a simple shape and make a template (Operations 5 and 6).

2. Roll out a rope of soft, plastic clay a little thicker than the walls of the proposed shape. If the rope cracks on bending, it is either too stiff or too sandy. The rope should vary from ⅜-in. diameter for small shapes to 1-in. diameter for very large ones. Roll each rope as needed.

3. Lay one end of the clay rope in the center of a wet slab of plaster. Work on a whirler if one is available. A bat with a slightly convex surface is preferred. A board, cardboard, or other surface may be used if a bat is not available. Coil the rope around the center, as shown in step 1, Figure 28, until a base of the desired diameter is made.

4. Rub the base with the fingers until the coils have united. Turn the base over and do the same with the underside. Avoid getting the base too moist, as the greater shrinkage may produce cracks. Avoid air bubbles, as they will blow out in firing.

5. Cut the base into a true circle. A pair of dividers may be used. Step 2, Figure 28, shows the base completed.

6. Lay a new coil of clay on the outer edge of the base, and continue until several coils have been laid on top of each other. The top surface of each layer may be shaped by the thumb and forefinger to better receive the next coil. One long rope can be laid in a continuous spiral, in which case care must be taken in leveling the top; or a separate rope can be used, the ends of which are joined to form a ring for each layer (see step 3, Fig. 28).

7. Rub the coils inside and out until the layers are welded, as shown in step 4, Figure 28. Use as little water as possible. The outside of the coils may be left, however, and geometric impressions added with a tool, all to show as decoration, if desired.

8. The sides should be widened or drawn in to conform with the design. Hold the template against the sides from time to time as the work progresses.

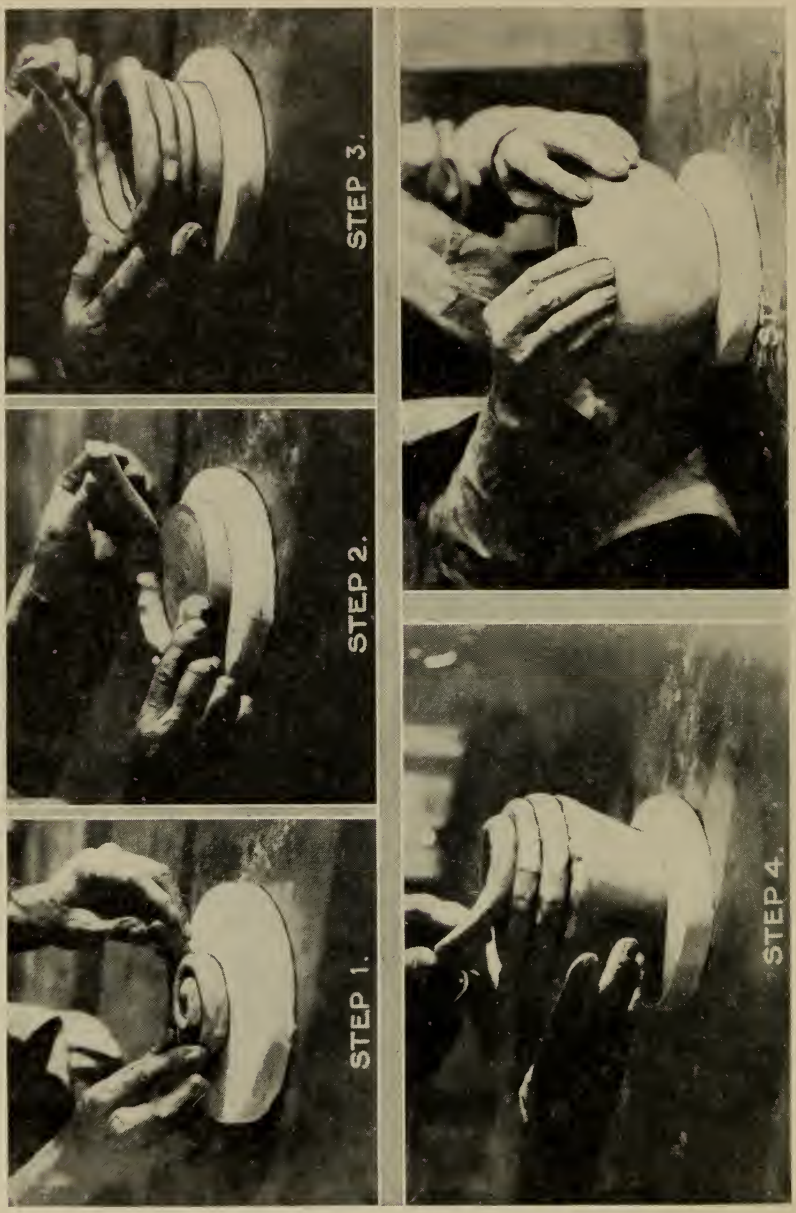

Fig. 28. Building with coils.

9. After the work has sufficiently stiffened, lay three or four more layers, as before, and continue until the shape is finished (step 5, Fig. 28).

10. A lid can be made if required by the design in the same manner as the base with the addition of a knob.

11. When stiff enough, remove the piece from the bat and smooth up any irregularities. Often the beginner can correct faults after the piece has dried with the use of a coarse file or rasp, and sandpaper.

12. All pottery must be dried slowly. When the rim has stiffened sufficiently, invert the piece to hasten the drying of the base. In handling green pottery, never lift a piece by the rim, but grasp it at the base.

b) Wheel Building

When a potter's wheel is available, much more accurate *building* can be done. This must not be confused with *throwing* on the wheel described in Operation 26, but consists merely of shaving the coils true as they are laid.

1. Build the shape on a bat on the potter's wheel in the same manner as in (*a*) in *hand building*. The approximate center and circumference of the intended base can be easily marked on the bat by starting the wheel and holding the point of a pencil against the revolving surface of the bat.

2. After the base and two or three coils have been laid, start the wheel and shave the walls inside and out smooth and true with a turning tool, steadying the hand with the turning stick as described in Operation 27.

3. Lay two or three more coils and shave as before, using the template from time to time as a guide.

4. Continue in this manner until the piece is completed.

5. Wipe the revolving surface of the clay with a damp sponge. A good finish may be obtained by holding a piece of damp leather against the revolving surface.

Operation 8 (Project 3, p. 17)

STICKING UP WITH SLABS

Bowls, trays, vases, dishes, etc., whose sides are planes or flat surfaces, can be made by *sticking up* clay slabs. Such pieces are usually rectangular, hexagonal, octagonal, or of irregular shape. Some modernistic designs lend themselves to this type of construction.

1. Design a shape made up of flat surfaces, and cut patterns of the different surfaces from a sheet of stiff paper or cardboard.

2. Roll out a clay slab of sufficient size and thickness (Operation 3).

3. On the clay slab, mark out the sides and base around the patterns, with a knife, cutting down to the cloth. Allowance should be made for the base to fit inside rather than under the slabs making up the sides.

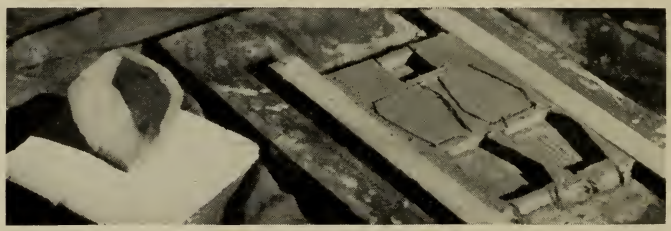

Fig. 29. Sticking up a vase with slabs, showing two sides and the base joined.

4. When tough enough to handle, yet soft enough to bend easily, carefully separate the pieces cut out in the preceding step, and bevel corresponding edges to fit.

5. Wet the adjoining edges of two sides with clay slip.

6. Press the edges together, and plaster the inside corner thoroughly with wet clay.

7. Proceed in the same manner with the remaining pieces. The base is usually put on before the remaining sides to make the work more rigid (see Fig. 29).

8. Dip the fingers in clay slip, and rub the outside corners. Be sure there are no weak joints.

9. Wipe inside and out with a soft, wet sponge. Hand rub when

leather-hard. Sometimes it will be found necessary to use a sandpaper block on the dry clay to obtain plane surfaces.

10. A lid can be made if required in the design by cutting a slab of clay to fit over the opening. By pressing around the edge of the cover on the underside with a piece of yardstick, a raised surface can be left to fit into the opening or mouth to prevent the lid from slipping. A suitable knob should be formed and attached (see Operations 9 and 10).

Operation 9

FORMING APPENDAGES

a) Handles and Knobs

Handles and knobs should be made in a manner to suit or match the body to which they are attached (see Fig. 30).

Knobs may be modeled, made with coils, slip cast, pressed, formed on the wheel, or turned. Handles may be modeled in any specially designed shape, made with rolls of clay, *pulled,* or pressed in a mold.

Fig. 30. Handles.

A pulled handle is made as follows:

1. Hold a pear-shaped ball of well-wedged and kneaded clay in the left hand with the small end down. It is important to have the clay with the right *pulling* consistency.

2. Pull the small end with a stroking motion into a flattened clay strip with the right hand. To do this, keep the thumb on top and the second joint of the index finger underneath the strip. Taper the strip slightly and break it from the ball of clay a little longer than necessary for the handle.

3. Determine where on the body the handle should join, and scratch

the spots with a pointed tool or nail to serve as a mark and to roughen them so the handle will adhere better.

4. Coat the spots with clay slip with the finger.

5. Hold the rim above where the handle is to be attached with the left hand, keeping the thumb on the outside.

6. Either blunt the larger end of the pulled clay strip and jam it against the upper spot, or crook the end and press the outside of the crook against the spot, holding it in place with the left thumb under the crook, keeping the fingers of the left hand inside the rim.

Fig. 31. Attaching a pulled handle.

7. Holding the free end of the handle between the right thumb and the second joint of the index finger as before, curve it as desired, and push the flat side (opposite the thumb) of the lower end against the lower spot (Fig. 31).

8. Keeping the thumb pressed against the lower joint, give the remaining end of the strip a delicate curve away from the body of the ware by a deft raising of the wrist.

9. Pinch off the excess clay, rounding the end, and smooth up the joints carefully with the finger or a modeling tool.

Pulled handles can also be bent as directed in the following for rolled handles, left to stiffen, and then attached as directed in Operation 10 (Fig. 32).

A rolled handle is made as follows:

1. Make a full-size layout on a piece of paper of the desired shape of the handle.

2. Roll out a thin roll or rope of clay, limber enough so it will not crack in bending.

3. Lay the roll on the paper and bend to the shape of the pencil line.

4. Cut off the excess clay at each end.

5. Let the handle stiffen, shape the ends to make a good joint with the body, and attach as directed in Operation 10 (Fig. 32).

Fig. 32. Attaching an appendage.

b) Spouts

Spouts may be divided into two general types, open and hollow. These should be observed on successful teapots, jugs, and pitchers. The lip of a spout should be so constructed that it will not drip.

Open spouts, either V- or U-shaped, placed at the rim, are usually found on pitchers and jugs. To make a small spout of this type, simply bend out the soft rim at a point opposite the place where the handles are to be attached, being careful not to crack the clay wall. Open spouts too large for this method are made as follows:

1. While the clay is still soft, carefully mark the intended position of the notch or opening where the spout is to be attached.

2. Cut a paper pattern shaped like a fan opened to an angle of from 1 to 1½ right angles. The radius of the arc should be from about 1 to 3 in. long, depending on the size of the pitcher or jug (Fig. 33).

3. Fold the pattern in the middle (dividing the angle in half) and then open the fold to a V shape, or bend it into a U shape as preferred.

4. Hold the paper spout against the mark on the body, bending, cutting, trying, and trimming the pattern until a satisfactory shape is obtained.

5. Remark the position of the V- or U-shaped opening on the rim of the body to fit the pattern.

Fig. 33. Attaching a V or U spout. Paper pattern shown at left.

6. Cut the V or U notch in the rim along the mark with a knife or a fine taut wire.

7. Roll out a small, thin slab or pancake of limber clay that will not crack when bent, about the thickness and consistency of the clay to which the spout is to be joined.

8. Lay the paper pattern flat on the clay slab.

9. Run a knife around the edge of the pattern, cutting the clay required for the spout.

10. Bend the clay the proper shape to fit the notch in the body.

11. Coat the edges to be joined with thick slip with the finger.

12. Press the edges of the spout against the edges of the opening with the right hand, supporting the wall from the inside with the left hand (see Operation 10).

Fig. 34. A tubular spout with strainer at base.

13. Weld and smooth the joint carefully inside and out with the fingers, using clay slip, and a modeling tool if necessary.

Hollow or tubular spouts, usually joined somewhere on the lower half of the body, are found, for example, on certain styles of teapots. Spouts of this type are usually slip cast in plaster molds. First, model a clay pattern of the spout, making it solid, with no hole through it. When the clay is fairly stiff, cast a two-piece mold around it, as directed in (*b*), Operation 15. Slip cast, as directed in Operation 19, and attach as directed in Operation 10 (see Fig. 34).

Heavier hollow spouts, straight or tapered, can be *thrown* on the potter's wheel (Operation 26) in the same manner as in making the walls of a very narrow bud vase, using first the finger and then a stick or pencil for forming the inside. These, of course, are attached in the usual manner (Operation 10).

c) Feet

1. Shape the foot with the fingers, modeling tool, or knife, as required, using stiff clay. Keep in mind both the strength and suitability of the design.

2. If a number of similar feet are needed, make a press mold (*a*, Operation 16) using the foot made as a pattern.

3. Press the required number of feet, using clay from the same wedging, so the shrinkage will be the same in each foot (see Operation 21).

4. Attach to the inverted ware as directed in Operation 10. It is safer to leave the piece inverted until after the first firing.

Operation 10

ATTACHING APPENDAGES AND ORNAMENTS

When the ware is tough enough to handle without making fingerprints, the handles, feet, spout, and other appendages, or ornaments, should be put on. For best results, the things to be attached should be of the same consistency and contain the same amount of moisture as the body to which they are to be fastened, so the shrinkage will be as nearly uniform as possible. Special directions for one method of attaching pulled handles are given in the directions for making them (see *a,* Operation 9).

1. Hold the appendage or ornament up against the body to determine exactly where it should go. Scratch the surface to serve both as a mark and to roughen it so the appendage will adhere better.

2. In case of a spout (see *b,* Operation 9), cut the opening in the body slightly smaller than the base of the spout. If a strainer is wanted, as for a teapot, punch a number of small holes instead of cutting one large one (Fig. 34).

3. Cover the surface where it joins onto the body with thick slip.

4. Quickly fasten in place by pressing against the body in the correct position (Fig. 32). Support the wall from the inside with the left hand if necessary.

5. Smooth the joints with the finger or modeling tool.

6. Set away to dry. If the appendage dries faster than the body, place a small piece of damp cloth over it to retard the drying.

Operation 11 (Project 4, p. 18)

MODELING FIGURES

Definition and Purpose

The term *figure* is here used to include all objects that might be modeled, other than the common pottery pieces described elsewhere in this book.

The term *modeling* in the stricter sense denotes the building up of figures with plastic material by beginning with little and adding to, piece by piece, until the end is achieved, rather than by the opposite methods of the sculptor. In a looser craft sense, the term sometimes implies the forming of figures by any other method using the fingers or hand tools.

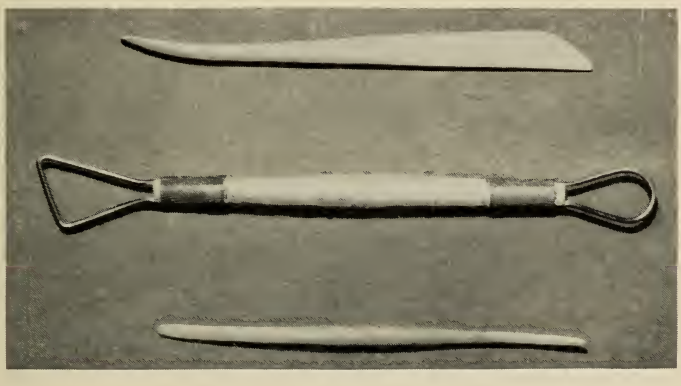

Fig. 35. Modeling tools.

At its best, modeling is one of the greatest of the fine arts, and as a craft it has wider scope and greater possibilities than any other branch of clay work. It is instinctive with children and seems to foster in them a love for art. It provides an outlet for their originality on the one hand, and trains their sense of imitation, observation, and appreciation on the other. Perhaps the greatest benefit to most is the stimulation of their dormant power of observation. The beginning modeler is quickly impressed with a realization that he has no real knowledge of the shape and form of familiar things; that he has been looking at things without actually seeing them.

The following instructions will necessarily be confined to aiding the beginner to grasp the fundamentals and to meet the mechanical difficulties of the art of modeling.

Tools and Equipment

The fingers produce the best modeling work and should be used as much as possible. Often, however, as in shaping an eye or mouth, tools will be necessary. Modeling tools are inexpensive and can be purchased at any art store; or they may be made by shaping the ends of small close-grained sticks, about 7 in. in length, to resemble, on a smaller scale and in various shapes, the ball of the thumb (Fig. 35). Sticks with various sized wire loops bound firmly to the ends are helpful when removing clay. Other equipment which may or may not be necessary are a soft sponge, a piece of oil cloth to work on, old cloths, a large pair of wooden calipers for measuring, a fine spray gun for dampening clay surfaces, scraps of wire, wood and pipe for reinforcements and armatures, an easel and board for relief work (Fig. 36), and an adjustable stand for large figures.

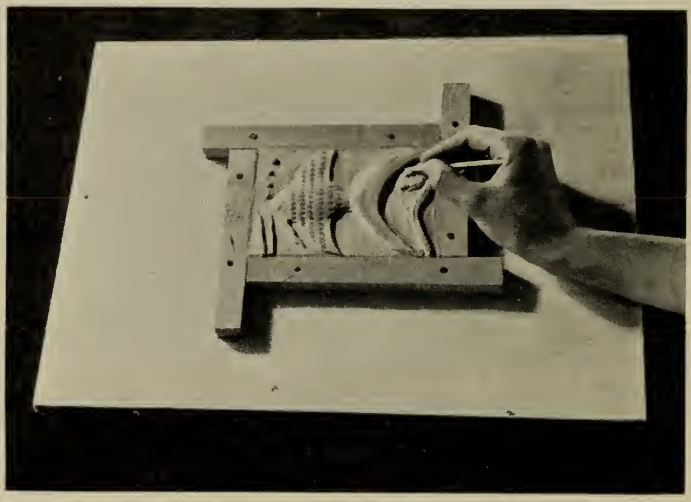

Fig. 36. An easel and frame for modeling relief work.

Materials

In choosing a modeling clay, both its plastic qualities and its shrinkage must be considered. It should be pliable and easy to manipulate, adhesive enough to stick and not be sticky, yet stiff enough to stay put and hold its shape. The problem of shrinkage and of keeping the clay in condition requires special attention in modeling. Smaller and more exposed parts, when left to themselves, dry out more quickly than others. Clay gets smaller as the moisture content

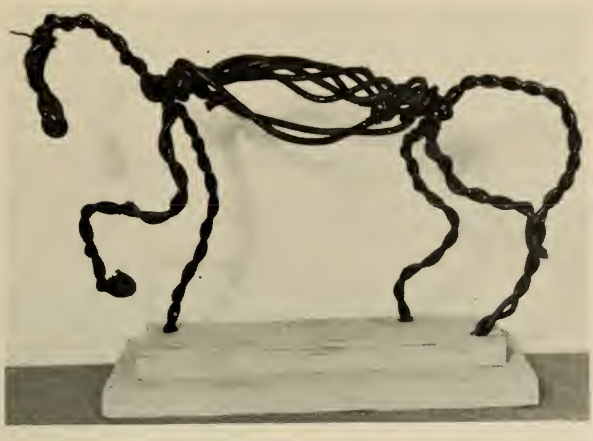

Fig. 37. A wire armature for a modeled figure of a standing animal.

becomes less, the drier clay tending to pull away from the damper mass, resulting in cracks and breakage. To avoid this, the clay must be kept damp until the work is complete or a mold is cast about it,

Fig. 38. A figure of an animal modeled on a wire armature.

by wrapping it in damp cloths and keeping it in a tight box, if possible, or in an outer wrapping of rubber or oilcloth. If the figure is to be dried for firing, the too hasty drying of the smaller parts must be retarded by moistening them with damp cloths or an atomizer, and their shrinkage kept in step with the more slowly drying parts.

To avoid this constant attention to the material, oil or glycerine can be mixed with the clay. This keeps it soft, but renders it unfit for firing. Similarly prepared clays, such as plasticine, can be purchased and come in various colors.

What to Model

The modeler should have a definite idea of what his figure should look like when finished before he starts to work. If it is to be original, he should at least roughly sketch a front, side, and top view which should be followed. Changes are more easily made in the sketch than in the clay. If the figure is to be copied, the actual subject, a modeled copy, or a picture, in order of preference, should be followed. The practice of playing with a lump of clay with the idea of seeing what form it is going to take, and then naming it, rarely produces results worthy of a name.

Fig. 39. A wire armature for the human figure.

The beginner should not at first attempt to model figures requiring supports and reinforcements, but should confine his efforts to more simple compact objects. Figures with relatively small supporting members, as is the case with many standing animals (Fig. 37) and with the human figure, require additional supports of wood, pipe, or skeletons of twisted wire, all of which prevents their being fired. Often it is possible, where the firing of a piece of this type is desired, to support it from without with a pillar of clay or other material which is removed carefully when the clay hardens. A slender neck can be supported in this way. Sometimes the shape of a figure, as a head, for instance, permits the use of a removable support or armature. A common form is a tapered post, the end of which is wrapped to the shape of a ball with heavy twine. When the clay stiffens sufficiently, the post is removed, and a few hours later the

twine unwound from the inside of the figure. Some figures, as reclining animals, can be made hollow by being built over a form or core of damp, wadded newspapers which are pulled out when the clay stiffens (Fig. 40). Reclining animals, small heads, fruit, etc., are favorite first subjects for modeling *in the round,* while flowers, leaves, fish, birds, and geometrical designs are suitable for working in low relief. High relief is a combination of the two foregoing types. To achieve artistic merit in relief is more difficult than *in the round,* for it involves the creation of an illusion, but from the mechanical standpoint, at least, it is more simple.

Fig. 40. A core for a modeled figure of a reclining animal.

General directions follow for modeling simple objects *in the round* without reinforcements, a head requiring internal support, and relief — three common types of work in this field.

a) *Simple Modeling in the Round*

1. Take a ball of very stiff clay for the center of the figure, as it does not have a chance to dry out as rapidly as the outside. Make it solid and roughly shape it by pounding and rolling in the hands. This will eliminate air pockets, an important precaution if the piece is to be fired.

Fig. 41. An animal modeled on a wadded newspaper core.

2. Roll out between the fingers a small pellet of clay not larger than a pea and begin building up the general mass of the figure. Lay it on with the ball of the thumb, welding it with a slight smearing motion if necessary.

3. Continue this process until the dominant mass or masses have been roughly blocked in. Pay no attention to even important details at this stage. Keep the finger ends moist with a damp sponge.

This method probably will have to be modified in the case of smaller children who will want to shape the whole object from one mass of clay, pressing and forming the parts, adding, at most, only the subordinate ones.

Fig. 42. A modeled surface considered as a series of planes.

It is very important at this point to stop and consider what has been done before going further. If the large masses are not correct from the beginning, all additional work, no matter how beautifully done, will be wasted and useless. Carefully compare the work with the model or picture, considering proportions of length, breadth, and mass. Correct errors before proceeding.

4. Build up the minor masses, using the same procedure as directed in the preceding steps for the larger masses. Carefully observe the relative position and size of the different parts. If possible, apply the shadow test at this point. When placed in exactly the same position in reference to the light, does the copy have the same general shadows as the model?

5. Now consider the general direction, size, and position of the more important surfaces and build them up roughly in the same manner as before. A standard method of approaching the problem of

surfaces is to consider the whole figure exterior as composed of a collection of various sized planes or flats (see Fig. 42). The figure is built up completely in this manner and then the planes are rounded, the corners softened, the surfaces smoothed, and the details added. Start with the larger planes, getting them in their correct size, shape, and relative positions, and so on down to the smallest facet. Ordinarily, do not touch the smaller plane until the larger one is right. This rule as well as other directions for modeling cannot be made to fit the special conditions of all cases as is illustrated by the example given of this procedure in the modeling of a head, which follows.

6. Put in the remaining details, again observing carefully relative positions. Use modeling tools where the fingers cannot do the work.

7. Smooth up all surfaces with the fingers.

b) Modeling a Head on an Armature

1. On a board about 18 in. square, erect a piece of wood 2 in. square, high enough to reach within an inch or so of the top of the intended figure (Fig. 43). Some additional pieces may be necessary near the top of the support to hold up the clay. If the figure is to include the shoulders, nail a crosspiece to the upright, at the proper height about 2 in. less than the shoulder span.

2. Press stiff clay about the armature, roughly building up the cylindrical neck and the slanting oval mass for the head. Be sure that the clay is so placed that none of the wood will come too near its surface.

3. First locate the pit of the neck (Fig. 45, Point 1), which should be close to the armature, and then the point of the chin (2) using these as a guide in locating other points. Fix these points and others that follow by the ends of small pegs or match sticks pushed part way into the clay. They should be built up to in the manner previously described, and later removed, and the holes filled.

4. Scratch a line (3) down the center of the surface of the oval through the point of the chin. Balance up both sides of the clay mass.

5. Measuring from the original when possible, locate important points in the following order. Locate the eyebrows (4) by describing an arc with the calipers, using the point of the chin as a center.

6. Describe two smaller arcs (5) on the clay from the same point for the approximate ear positions.

7. Locate as near as possible the point of the nose (6), getting it the correct distance from the chin and from the surface.

8. From the end of the nose peg as a center, describe arcs (7) again for the ear positions, cutting the arcs previously made, thus definitely locating the ear centers (8).

9. Correct the distance between the ears.

Fig. 43. An armature for a modeled head.

Fig. 44. A modeled head.

10. Scratch a horizontal line for the mouth (9) and locate the corners. Build up firmly around all pegs.

11. Consider the surface as a collection of planes in the manner explained in the directions for "Simple Modeling in the Round" under (*a*).

Use the peg ends in locating the position and size of the planes, roughly building the more important ones in the following order:

a) The large plane forming the front of the forehead.

b) The two planes forming the sides of the forehead.

c) The three small planes forming the two sides and the bottom of the nose.

d) The two planes forming the fronts of the cheek bones.

e) The two large planes below the sides of the forehead.

f) The plane between the nose and the point of the chin.

12. Hollow out the eye sockets as in a skull (10).

13. Form two equal balls to fill the eye sockets and put them in place.

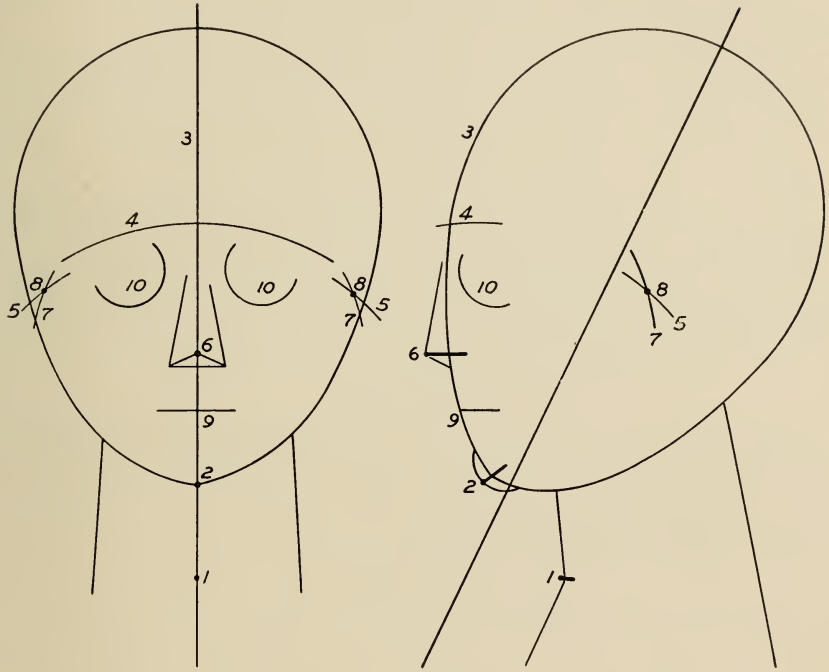

Fig. 45. A chart showing the order of locating points and lines in modeling a head.

14. Form the smaller planes, build up the remaining parts, correct the profile, fill in the details, round the surfaces, soften the corners and finish, using modeling tools when necessary.

c) Modeling in Relief

1. Draw the outline of the design on tissue paper.

2. Roll out a stiff clay slab (Operation 3) on a board which can be placed on the table or on an easel. Do not remove the slab form sticks (Fig. 36).

3. Lay the design on the slab and go over the outline with a pencil.

4. Remove the paper and with a pointed tool retrace the impression of the outline.

5. Roughly build in the main masses with pellets of clay, as previously described, welding them securely to the base.

6. Establish the chief high points of the design.

7. Lower the hollows where necessary, establishing the low points. Be sure everything is correct, before going ahead.

8. Build in the subordinate masses, finish up the surfaces and put in the detail, using modeling tools where the fingers are inadequate. Avoid getting the surface of the slab wet, keeping the fingers barely damp.

9. If the relief is to be fired, let it dry very evenly and slowly, retarding any small details that otherwise may dry and crack off.

This type of modeling usually offers interesting possibilities in color decoration (Operation 31). Be careful not to use a thick glaze which will fill up and hide the delicate details.

Conclusion

Figures that are to be fired must be dried much longer than ordinary pottery and the first half of the biscuit fire must be more gradual. Consult Operations 17, 18, and 24 for making figure molds and plaster casts for figures that cannot be fired.

CHAPTER VI

MAKING HAND MOLDS

Operation 12

SIZING

When a mixture of plaster of paris and water is to be poured on a wood, plaster, metal, or linoleum surface, the surface should be sized to keep the plaster from sticking. Do not size an unbaked clay surface, as the water in the size will soften the clay and cause it to become sticky. The purpose of sizing a surface is to make it nonabsorbent, and other materials that will do this, such as linseed and other oils, waterglass, shellac, grease, etc., are sometimes substituted.

a) Preparing Size

1. Cut up a large bar of soap, preferably castile, in a quart of water in a pan.

2. Simmer on the stove until the soap is entirely dissolved. Then stir in one-fourth pint of paraffin or sweet oil.

3. Set aside to cool. When cool, the mixture should have about the consistency of maple syrup.

b) Applying Size

1. Lay the size on the surface with a brush. A shaving brush is excellent.

2. Wipe it off with a damp sponge.

3. Apply a second coat of size, and wipe as before.

4. Apply a third or fourth coat, if necessary, until the sized surface rejects water as though it were greased.

5. Do not apply water to the last coat of size, but wipe with a sponge dampened in the size. (A single coat of size will often suffice for metal, glass, or wood surfaces. Plaster usually needs three or four coats.)

6. A surface, after sizing, may be wiped with a rag dipped in olive oil, but care should be taken to wipe off all surplus oil.

Operation 13

MIXING AND POURING PLASTER

Plaster of paris is used in pottery for making molds, bats, drying bowls, patterns, and the like, because of its property to solidify when mixed with the proper proportion of water, and also because of its ability, when in this dry, solid state, to absorb moisture from wet clay. It is obtained from the mineral gypsum, a native hydrated sulphate of calcium. When baked, gypsum loses part of its water, but retains the power of recombining with water to form a hard solid mass. It is this power that gives value to finely ground dehydrated gypsum, or plaster of paris, as it is called. It should be stored in a very dry place or it will absorb moisture from the air. The chemical formula of gypsum is $CaSO_4.2H_2O$. Driving out the water leaves $(CaSO_4)_2.H_2O$.

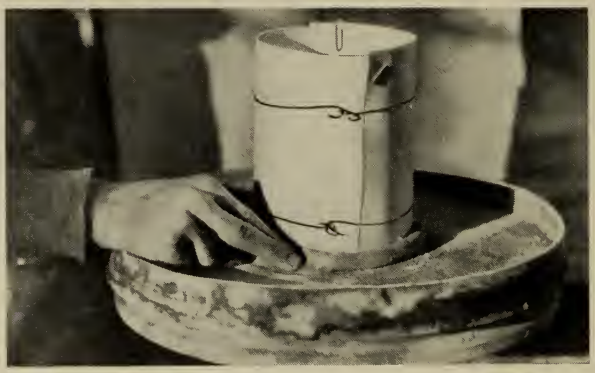

Fig. 48. Sealing up a pasteboard form for a plaster cylinder.

Method 1: Potters'

1. Roughly calculate the number of cubic inches to be filled with plaster, and divide this amount by 80. This will give the approximate amount of water to use in quarts. Multiply this quotient by 2¾. This will give the amount of plaster to use in pounds. In other words, use the proportion of 1 qt. of water to 2¾ lb. of dry plaster of paris. One quart of water and 2¾ lb. of plaster of paris will make about 80 cu. in. of solid plaster.

2. Put the water in a wide-mouthed earthenware jar, tin can, or other container of sufficient size, and slowly sprinkle the plaster into the water.

3. Stir with the hand into a smooth cream, removing all lumps and bubbles.

4. Continue stirring gently until you feel the mixture thicken. Immediately pour it into the form which has been prepared previously (Fig. 49). The proper moment for pouring is when the plaster forms a coating upon the hand which cannot be shaken off. If poured too soon, it will curdle and water will rise above the plaster. If poured too late, it will be too stiff. There is an old saying among potters that "time, tide, and plaster wait for no man." Always have a few sized pie pans placed on a level surface for any excess plaster. Jar the plaster in the pans level, and dump it out when hard. The plaster disks thus made may be used as work bats.

Fig. 49. Casting a plaster cylinder on a potter's wheel for making a pattern.

5. Quickly wipe the inside of the jar and the hands with newspapers. Wash out the jar immediately in a tub used for that purpose. Never, under any circumstances, pour any plaster into any plumbing as it will clog up the drain.

6. The setting of the plaster will be completed when it grows warm. This usually takes about ten minutes, but the plaster does not get real hard for several hours. If it is desirable to retard the setting for any reason, add a small amount of glue at the time of mixing. Ten per cent of glue, for example, will retard the setting of the plaster for two hours.

Method 2: Artists'

1. Estimate the amount of water needed and put it in the mixing jar.

2. Sprinkle the dry plaster in the water until it will absorb no more. This can be told when the plaster rises level with the surface and little dry islands of plaster float on the water. Do not stir until the amount of plaster has been determined.

3. Now stir the mixture carefully to avoid making bubbles, preferably with the hands.

4. When thoroughly mixed, and just before it starts to set, pour the plaster in the form or mold as intended. If it is to be used in making a waste mold, the throwing of the plaster on the pattern must be begun in time, as it takes longer than pouring.

Operation 14

MAKING PLASTER PATTERNS

In making plaster molds for slip-casting and pressing round shapes, a pattern around which the mold is cast is necessary. This can be turned from a plaster cylinder on a lathe as is done in the industry or on a potter's wheel, as described below, or it can be built by hand or made on the wheel with clay, or a piece of glazed pottery or glassware may be used. Patterns of original design, of course, are preferable.

a) *On a Potter's Wheel*

1. Design a shape (Operation 5) suitable for casting (see Operation 15), and make a template (Operation 6).

Fig. 50. Turning a plaster pattern on the potter's wheel.

2. Soap size the face of the wheel (Operation 12). The wheel should be provided with joggles (projections or depressions) on its face to prevent the plaster from slipping, as shown in Figure 107.

3. Make a hollow cylinder of flexible cardboard or linoleum to be used as a form, and tie it around with twine or wire near the ends and at the middle. It should be at least ½ in. larger in diameter than the designed shape, and about 4 in. higher.

4. Place the form in the center of the wheel, and hold it in place with a rope of soft clay on the outside at the base, as shown in Figure

48. Press the clay firmly in the angle, and plaster up the joints with clay so the mixture will not run out.

5. Mix and pour plaster to fill the form (Operation 13, Fig. 49).

6. As soon as the plaster sets, remove the cardboard or linoleum form.

7. The cylinder should now be turned before the plaster becomes too hard. Push the point of the turning stick into the board support back of the wheel at a point level with the plaster cylinder, and hold it with the left hand in a horizontal position to the right of the cylinder as shown in Figure 50.

8. Start the wheel with the right side moving away from you.

9. Hold a turning tool with a convex cutting edge in the right hand, and, bracing the wrist firmly on the turning stick, move them together in such a manner that the cutting edge of the tool will come in contact with the revolving cylinder at right angles to its surface as shown in Figure 50. Make light cuts so the cylinder will not be jarred loose from the wheel. If the cylinder should be jarred loose spread a thin layer of clay slip on the wheel head and re-center the cylinder.

10. Rough out the shape, base up, being guided by the cardboard template. If a mold with a separate piece for the base, of the shape shown as type 4*b*, Figure 53, is to be made from the pattern, leave a 2-in. waste or *spare* at each end. The waste at the mouth of the pattern will be the shape of the hole in the mold through which the slip is poured, and should be the same diameter as the mouth throughout. The waste at the base (this will be at the top of the plaster cylinder) will be the shape of the bottom piece of the mold, and should be made slightly smaller in diameter than the base, next to the pattern, but should be made with a convex ridge about ¾ in. wide and ½ in. high around it. This will prevent the base piece of the mold from falling out when the mold is assembled. If a mold is to be made with no separate piece for the base, as types 1, 2, 3*a*, 3*b*, or 4*a*, Figure 53, no waste or *spare* should be left at the base of the pattern. The base should be cut slightly concave so the finished piece will stand firmly.

11. Carefully shave the pattern to fit the template, using a turning tool with a straight cutting edge for the convex portions, and one with a rounded cutting edge for the concave portions.

12. When the plaster is sufficiently dry, smooth the pattern with

fine sandpaper. This is done by holding the sandpaper lightly against the revolving pattern. Shallow designs may be cut in the plaster.

13. When thoroughly dry, soap size the pattern to make it non-absorbent (Operation 12).

b) On a Lathe

1. Design a shape (Operation 5) suitable for casting (see Operation 15), and make a cardboard template (Operation 6).

Fig. 51. Casting plaster cylinder with wood core, used to turn pattern on lathe.

2. (*a*) Roll a 1-in. strip of stout paper spirally around a long, tapered lathe mandrel, gluing the edges so that it will not unroll. When dry, remove the paper cone from the mandrel, and trim it square at the base so that it will stand perpendicularly on a horizontal surface.

b) If no suitable mandrel is at hand, the following method can be substituted, though it is not as satisfactory. Take a piece of wood, either round or square, about 1 in. thick, taper it slightly, and saw it 3 in. longer than the height of the designed shape. This is to be used as a core for the plaster cylinder, to support it between the lathe centers. Saw across each end of this core two saw kerfs, about ⅛ in. deep, at right angles to each other, crossing at the center to form suitable recesses to receive the lathe centers. To prevent the core from swelling and cracking the plaster, dry it and then thoroughly boil it in linseed oil.

3. Size or oil a portion of the table or a smooth board, and the metal surfaces of the lathe which are likely to get splashed with plaster when the pattern is turned (Operation 12).

4. Set the paper cone or the wooden core upright in the center of the prepared surface and secure it with small pieces of soft clay.

5. Make a hollow cylinder of linoleum or flexible cardboard to be

used as a form, and tie it around with twine or wire near the ends and at the middle. It should be at least ½ in. larger in diameter than the designed shape and 4 in. higher.

6. Place the cylinder around the upright cone or the wooden core. The cone or core should be in the exact center of the cylinder (Fig. 51).

7. Carefully press a rope of soft clay around the base of the form, as shown in Figure 48, to hold it in position and to prevent leakage of the liquid plaster.

8. Mix and pour plaster to fill the form, being careful not to disturb the paper cone or wooden core (Operation 13).

9. When the plaster sets, remove the form.

10. The cylinder should now be turned before the plaster becomes too hard. Place the plaster cylinder upon the mandrel and screw the mandrel to the lathe head. If the cylinder has a wooden core instead, place it between the lathe centers.

11. Clamp the tool rest level with the center of the cylinder and close to it.

12. Start the lathe, keeping it on low speed.

13. With a round-nosed scraping tool, rough out the shape, being guided by the cardboard template (Fig. 52). If a mold with a separate piece for the base as Type 4*b*, Figure 53, is to be made, leave a 2-in. waste or *spare* at each end. The waste at the mouth of the pattern will be the shape of the hole in the mold through which the slip is

Fig. 52. Turning a plaster pattern on a lathe. Cutting concave portions with a round-nosed scraping tool.

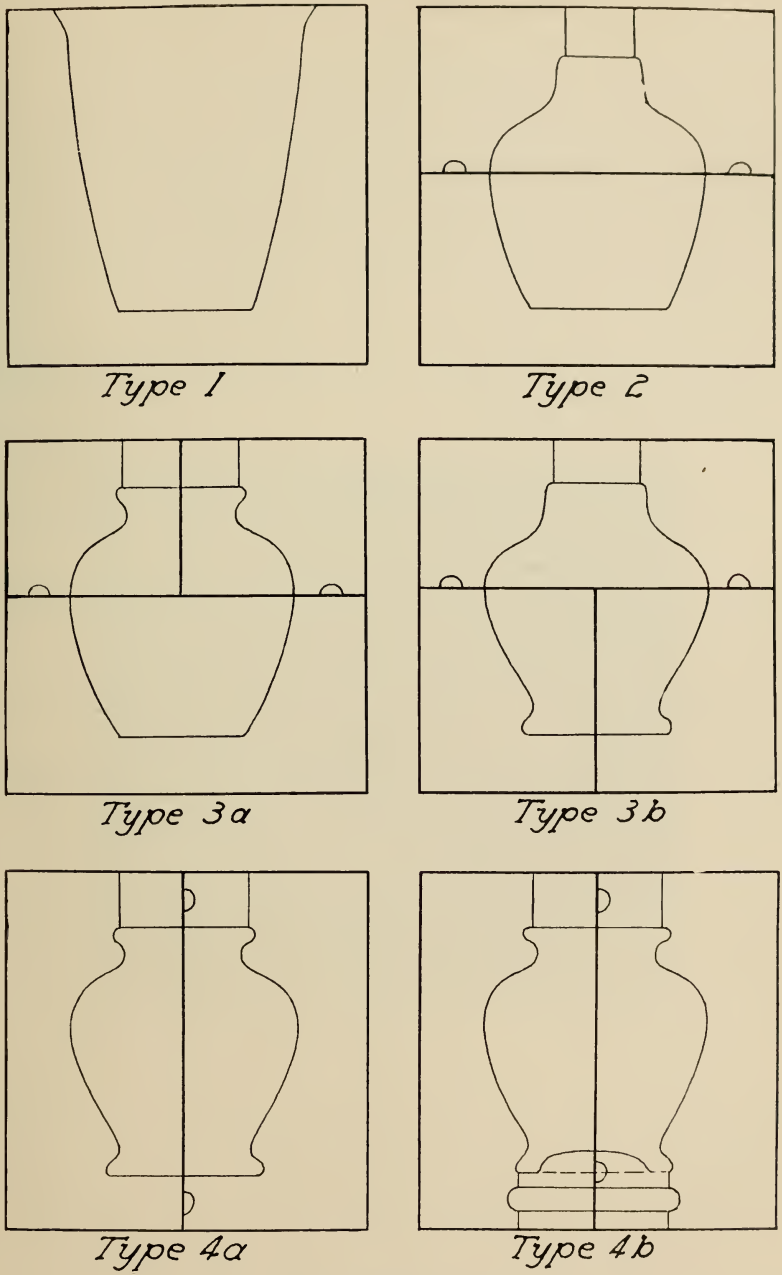

Fig. 53. Types of molds.

poured, and should be the same diameter as the mouth throughout. The waste at the base will be the shape of the bottom piece of the mold, and should be made slightly smaller in diameter than the base next to the pattern, but should be made with a convex ridge, about ¾ in. wide and ½ in. high, around it. This will prevent the base of the mold from falling out when the mold is assembled. If a mold is to be made with no separate piece for the base, as Types 1, 2, 3*a*, 3*b*, or 4*a*, Figure 53, no waste or spare should be left at the base of the pattern. The base should be cut slightly concave so the finished piece will stand firmly.

14. Carefully shave the pattern to fit the template, using a wide square-nosed scraping tool for the convex portions and a round-nosed tool for the concave portions.

15. When the plaster is sufficiently dry, smooth the pattern with fine sandpaper. This is done by holding the sandpaper lightly against the revolving pattern. Shallow designs may be cut in the plaster.

16. Remove the pattern from the mandrel. If the pattern has a wooden core instead, carefully tap the small end of the core until it is loosened, then remove it. Clean the lathe thoroughly.

17. When thoroughly dry, soap size the pattern to make it non-absorbent (Operation 12).

18. Fill the mandrel or core hole with soft clay before using the pattern.

Operation 15

MAKING SLIP MOLDS

Plaster molds are made by casting plaster of paris about a pattern in one or more sections, depending, as explained farther on, upon the shape of the design. The pattern may be made of plaster (see Operation 14), green clay, finished pottery, or glassware. For the craftworker, a pattern of his own design is, of course, desirable. If a finished piece is used as a pattern, its mouth must be stopped with clay so the plaster will not run inside, and a clay *spare* formed to make the opening in the mold through which the clay slip will be poured as shown in Figure 60. Either raised or incised designs made in the

Fig. 54. Pouring a one-piece plaster slip mold (Type 1, Fig. 53).

pattern will be reproduced in the ware. When a mold of more than one piece is to be made, the usual method is to block off by burying in soft clay or wet sand all the surfaces of the pattern except that to be covered by the first section of the mold to be cast. After this is cast, the second section is cast with the first section in place, and so on. Directions for this method follow.

A piece of oiled paper or oilcloth should be used to protect the table, or the surface may be soap sized (Operation 12). Cylindrical forms to hold the liquid plaster can be made of linoleum or flexible

cardboard tied with twine or stovepipe wire as illustrated in Figure 54. Rectangular forms can be made with boards nailed at the corners, as shown in Figure 59. When finished, molds should be put in a warm place to dry thoroughly.

Molds for vases, jars, and the like, may be grouped into four general types. These are shown as Types 1, 2, 3*a*, 3*b*, 4*a*, and 4*b*, Figure 53. Decide which type of mold will be correct for your pattern, being guided by the following considerations:

1. If plaster were cast all around the pattern up to the mouth, could the pattern be removed without breaking either it or the plaster? If it could be thus removed, a one-piece mold, like the one shown as Type 1, would be suitable. If it cannot be removed, a two or three-piece mold must be made.

Fig. 55. Dividing a pattern in half perpendicularly with a try square.

2. Mentally, divide the pattern with a horizontal line at its widest part. If a plaster mold were cast around the pattern and divided horizontally at this imaginary line, could the top half of the mold be lifted off? Could the pattern be lifted from the lower half of the mold? If they could, a two-piece mold divided horizontally, of the kind shown as Type 2, should be made.

3. If either the upper or lower part of the pattern has a *return* which prevents its removal from that half of the mold, the latter must be divided perpendicularly in half, making a three-piece mold of the kind shown as Type 3*a* or 3*b*.

4. If both the upper and lower parts of the pattern have *returns* which would prevent the removal of both the top and the bottom halves of a horizontally divided mold, a mold should be made which is divided in half perpendicularly, making a two-piece mold of the kind shown as Type 4*a*. If the surface of the base of the pattern of this type is very concave, that part of the mold must be cast separately, making a three-piece mold of the kind shown as Type 4*b*.

a) *One-Piece Mold*

1. Use a pattern of the type shown as Type 1. Lay it bottom up on the table as shown in Figure 54.

2. Surround it with a cylinder, made of sized linoleum or flexible cardboard, which is at least 4 in. larger in diameter than the greatest diameter of the pattern, and which extends at least 2 in. above any portion of the pattern.

3. Tie a string or wire around the cylinder near the bottom and another near the top.

4. Press a rope of soft clay around the bottom where the cylinder touches the table, and plaster up the joints with clay.

5. Mix enough plaster (Operation 13), and fill the form as illustrated in Figure 54.

6. When the plaster is hard, remove the form, and then carefully remove the pattern by tapping the inverted mold.

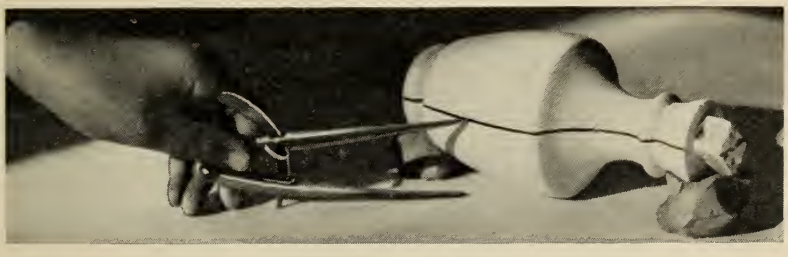

Fig. 56. Dividing a pattern in half with a pair of dividers.

b) Two-Piece Mold

1. Use a pattern of the type shown as Type 2 or as Type 4*a*, in Figure 53. There should be a *spare* at the mouth of the pattern to make the opening in the mold through which the slip will be poured.

2. If the pattern is of the type shown as Type 2, draw a pencil line around it at its widest part parallel to the base. If it is of the type shown as Type 4*a*, draw the line in such a manner as to divide it perpendicularly into two equal parts. Figures 55 and 56 show two methods that may be used for drawing the perpendicular dividing line.

3. Imbed the pattern in soft clay up to the pencil line, as is shown in Figure 57. Wet sand in a box can be used instead of clay if preferred.

4. Smooth and level the clay or sand even with the pencil line, being careful not to get any on the exposed portion of the pattern.

5. Make a form to surround the imbedded pattern at a distance of

Fig. 57. Imbedding a pattern in clay for a two-piece mold (Type 4a, Fig. 53).

about 2 in. from it, using linoleum or flexible cardboard in the form of a cylinder as shown in Figure 58; or, if more suitable, with boards in the form of a rectangle, as shown in Figure 59.

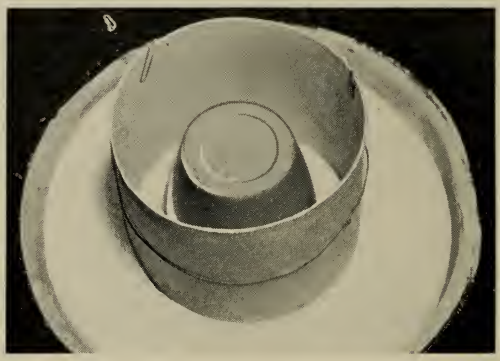

Fig. 58. A pattern and form imbedded in sand or clay ready for casting the first half of a plaster mold (Type 2, Fig. 53).

6. Imbed the bottom edge of the form in the clay or sand with the pattern in the center (Fig. 58). The top edge or rim of the form should be at least 1½ in. above the pattern. Be sure the form is sufficiently strong and tight to hold the liquid plaster.

7. Fill the form with plaster (Operation 13).

8. When the plaster is hard, remove the form and the clay or sand; invert and carefully wipe the exposed portion of the shape or pattern.

9. Make holes for joggles in the plaster where it fits against the second half, as shown in Figure 60. These are to keep the parts of the mold from slipping while in use.

10. Clean and size the exposed portion of the plaster upon which the second half of the mold will be poured.

Fig. 59. Pouring a square mold.

11. Place the lower edge of the form around the plaster just cast, with the top edge about 1½ in. above the pattern. Bind it securely in place with wire or string, as shown in Figure 61. If the form is made of boards, it may be wedged in place. Plaster up all cracks with clay.

12. Mix and pour plaster to fill the form as before.

Fig. 60. The first half of a two-piece mold (Type 4a, Fig. 53).

13. When the plaster is hard, remove the form, and carefully pry the upper half of the mold loose by inserting a knife blade between the halves. Remove the pattern (see Fig. 62).

Fig. 61. A pasteboard form around the first half of a two-piece mold, Type 2, ready to pour the second half.

c) Three-Piece Mold

1. The large section of a three-piece mold for a shape shown as either Type *3a* or *3b*, in Figure 53, is cast as directed above for the first half of a two-piece mold (Type 2). To cast the two remaining sections, the pattern is replaced in the section just cast and the space for one of the sections blocked off with clay. The second piece is cast, the clay removed, and the final piece cast in the same manner as directed above for casting the last section of a two-piece mold.

Fig. 62. A two-piece mold (Type 4a, Fig. 53).

2. A three-piece mold (Fig. 63) for a pattern of the type shown as Type 4*b*, Figure 53, is first cast as a two-piece mold, except that there should be a *spare* of plaster or clay at the base of the pattern as shown in Figure 52. Follow the directions given for making a two-piece mold of the type shown as Type 4*a*. Then remove the *spare*, and size the base of the pattern and the portions of the mold which surrounded the *spare* (Operation 12). Reassemble the mold with the pattern in place, and fill the space previously occupied by the *spare* with plaster (Operation 13).

Fig. 63. A three-piece mold (Type 4b, Fig. 53).

Other Methods

Frequently time may be saved by casting two or more sections of a mold in one piece, and then separating them by cutting nearly to the pattern with a saw and breaking them apart with a chisel.

Sometimes a fine wire can be laid along the dividing lines on a pattern, with the ends extending beyond the form. When the plaster is cast in one piece about the pattern, the ends of the wire are pulled in such a manner that the mold will be cut into its several parts.

Another short cut can sometimes be used when making a two-piece mold. If the pattern can be suspended in the form so that the dividing line is in a horizontal plane, the plaster can be poured up to the line to make the first half, and, after making joggles and sizing as directed above, poured on up to the top of the form to complete the mold.

d) Casting a Case

In industry, when a large number of duplicate molds are to be made and it is desirable to preserve the original pattern, a plaster *case* is made, around which the duplicate molds are cast.

1. Thoroughly size the inside of the original mold (Operation 12). (This master mold, or *block,* cannot be used for casting pottery, as the size fills up the pores in the plaster so that it cannot absorb the water in the clay *slip.*)

2. Assemble the mold if it is of more than one piece and tie it with stovepipe wire or twine.

3. Mix plaster and pour the mold level with the top (Operation 13).

4. When the plaster is hard, untie the mold and remove the *case.*

5. When thoroughly dry, size it (Operation 12).

When making duplicate molds, both the *case* and the original or master mold in which the case was cast are used. Place the *case* in the master mold and remove the part to be cast first. Place the form around the mold, and pour plaster in the space made by the removal of the part. Remove the part to be cast next and fill the space with plaster as before. Continue in this manner until all the parts are cast.

Operation 16

MAKING PRESS MOLDS

Molds for pressing hollow pieces with clay slabs (Operation 20) are identical with either *slip molds* (Operation 15) or some types of *piece molds* for figures (see *a,* Operation 17), and will not need to be considered here. The following molds are intended for pressing and squeezing only, but it is possible to slip cast in many one-piece press molds.

Fig. 64. A squeeze mold for a cup handle.

a) One-Piece Press Molds for Tiles, Small Figures, Ornaments, and Appendages

1. Patterns must have no returns or undercuts to prevent the cast from *pulling* successfully in one direction.

2. Place the pattern bottom down on an oilcloth or sized surface.

3. Build a suitable form of boards, linoleum, or clay about the pattern and fill it with plaster the same as directed in making a one-piece slip mold (see *a,* Operation 15).

b) Two-Piece Squeeze Molds for Small Figures, Ornaments, and Appendages

1. Draw a line around the pattern, dividing it into two parts, so that neither part will have returns or undercuts to prevent it from *pulling* successfully from the mold.

2. Proceed in the same manner as directed in making a two-piece slip mold (see *a* and *b,* Operation 15) except first, that no hole will be left for pouring slip, and second, that a U- or V-shaped groove about ¼ in. deep must be cut in both halves close to and all around the depression made by the pattern, as shown in Figure 64. This groove is to receive the surplus clay when the piece is being pressed.

Fig. 65. Casting the bottom and top halves of a flatware hand mold.

c) Hand Molds for Flatware

In making a two-piece press mold for flatware, such as plates or shallow dishes (Fig. 65), cast the first half over the inverted pattern as directed in making a one-piece mold (see *a,* Operation 15). The second half is made in the same manner as directed in making the second half of a two-piece mold (see *b,* Operation 15) except that no hole will be left for pouring slip. Make the halves 2 or 3 in. thick to withstand the pressure.

Operation 17

MAKING FIGURE MOLDS

Modeled figures vary so in shape and size that careful thought must be given to decide which type of mold and what type of mold work is most suited to a particular piece.

Plaster molds intended only for figures are considered in this operation, though types previously described are used in some cases as noted in the following suggestions:

1. Low relief on slabs, or ornaments and small figures having no returns, are usually pressed solid in one-piece molds described at *a*, in Operation 16.

Fig. 66. A press or slip figure mold.

2. Small figures with no returns on either half can be pressed solid in a two-piece squeeze mold, described at *b*, in Operation 16.

3. Many figures with no special undercut or return problems may be slip cast, pressed with clay slabs, or, if small, they may be pressed solid, in either the figure piece molds described in *a* of this operation or in molds (Figs. 66 and 67) made in the same manner as slip molds (Operation 15). At times, when lightness is not a virtue, the slip cast figure may be found to lack the heft and sturdiness found in the pressed figure.

4. Figures that cannot well be preserved in clay, because of the difficulty or impossibility of firing them, are commonly cast in plaster in the piece molds or waste molds described in *a* and *b* of this operation (see Fig. 69). Clay figures with internal supports or reinforcements, such as Figure 38, large solid figures, as Figure 44, and many special shapes will neither dry nor fire successfully.

Fig. 67. A slip figure mold.

5. Pieces with extensive undercutting, or involved returns which would require too intricate piece-mold construction, are also cast in plaster because of the necessity of using waste molds, in which only plaster can be cast. Of course, almost any figure may be cast in plaster if preferred, and a plaster cast may be made in practically any mold except a squeeze mold, but as the inside surface of molds in which plaster casts are made, must be made nonabsorbent by sizing, they cannot be used for clay work thereafter.

6. Where only a single plaster cast of a figure is wanted, a waste mold is usually made because it is easier to make and requires less material than the other types.

7. Often difficult figures can be pressed in clay if certain parts of the pattern, such as an extended arm or leg, are cut off and separate molds made of them. The pressed parts are afterwards joined to the body with slip in the manner of an appendage (Operation 10).

a) Piece Molds

1. If the figure or pattern is made of material other than green clay, it should be thoroughly sized (Operation 12).

2. Study the figure carefully to determine the best way to divide the mold pieces so that they will *pull,* or come away from the cast freely. Begin with one of the larger surfaces, studying the surrounding hollows and details. How large can the mold piece be made without encountering undercuts which would break either the cast or the mold in the pulling operation? Divide the whole figure in this manner, making as few pieces, of course, as possible, but being sure each one will lift nicely from the cast.

3. Roll out a slab of stiff clay about ¼ in. thick (Operation 3).

4. Cut the slab into strips about ¾ in. wide, with a knife and ruler.

5. Build a clay wall around the first mold piece to be cast by setting a strip on edge along the dividing line, blocking off the rest of the figure. Buttress the wall on the outside with clay at any point where support is needed.

6. Mix just enough plaster to fill the enclosure to the top of the wall (Operation 13).

7. Cast the piece by throwing the plaster on the surface, or, if possible, by pouring. Make the piece of uniform thickness, building up convex surfaces or bulges.

8. When the plaster sets, remove the clay wall.

9. Remove the piece from the pattern carefully, and trim any rough places on the edges. The inside edge of the piece should be square with the surface of the pattern if possible.

Fig. 68. A piece mold for a figure with a one-piece outer jacket.

10. Make several joggles or shallow holes along the edges in which the adjoining pieces will fit.

11. Size the edges of the piece, being careful not to get any size on the inside, if casts of clay are to be made.

12. Wipe off any clay left on the pattern.

13. Replace the mold piece in position.

14. If the mold is to be of more than two pieces, complete the wall around the area for the second piece to be cast with a clay strip as before, the first piece serving as part of the wall.

15. Cast the second piece in the same manner as the first, and so on, until all the pieces are cast. Protect the pieces already cast from splashing with a piece of dampened newspaper.

16. With all the pieces fitted on the pattern, trim up the outside of the mold where needed.

17. If the completed mold will not tie up easily because of its shape or its large number of pieces, an outer jacket of plaster, usually of two pieces, must be cast around it. This is done in the same manner as the mold, the assembled pieces being used as the pattern. The outside of the mold first must be sized thoroughly (Operation 12), so the outer case will not stick to it.

b) Waste Molds

A waste mold is one which must be broken or wasted when being removed from the plaster cast made in it on account of the undercuts and returns on the surface of the cast. Molds which could be removed without breaking and used again for figures of this type usually would consist of many pieces, and where only one copy or cast of the figure will suffice, the extra labor of making a permanent figure piece mold is saved by using a waste mold.

Being used only once, and removed by chipping away, it is not necessary or desirable to make the walls of the waste mold heavy and strong as in standard pottery molds. In addition, it would be difficult to construct forms about most modeled figures that would not result in extra heavy molds using an excessive amount of plaster. To save both materials and the labor of making forms, a shell of plaster about the pattern is made by throwing the liquid plaster against it a little at a time, rather than pouring the plaster around it as is done when a form is used. This method of applying the plaster

can also be used to advantage for making permanent figure molds for pressing, slip casting, or making plaster casts, as explained in step *a* of this operation.

1. If the opening of the intended mold (usually at the bottom of the figure) will be large enough to remove easily through it all the clay and any reinforcements or armature of the figure or pattern, a

Fig. 69. Making a waste mold. Note small squares of tin stuck in the soft clay to form a fence which serves to separate the mold in two parts.

one-piece waste mold can be made. Otherwise, it will be necessary to make a mold of two, or possibly more, pieces. If this is the case, carefully consider how best to divide the parts of the mold so they can be removed from the pattern without striking any of the reinforcements, and lightly mark the division lines on the damp clay figure or pattern.

2. Make a wall on these lines by imbedding small square pieces of

thin sheet metal to a depth of about ⅛ in. (Fig. 69). These may be cut from a tin can, or better, from thin sheet brass, and should be from ¾ in. to 1 in. square. These steps will be disregarded, of course, if a one-piece mold is being constructed.

3. Estimate the necessary amount of water to mix plaster for a ⅛-in. coating of the pattern, and pour it into the mixing jar. The purpose of this thin coat, made of colored plaster, is to act as a danger signal when the mold is being chipped off the cast, as is explained in *a,* Operation 24, Making Plaster Casts in Waste Molds.

4. Tint the water with one of the following coloring agents: laundry bluing, ink, yellow ocher, burnt umber, or raw sienna.

5. Mix the plaster as directed in the second method, Operation 13, sprinkling the dry plaster into the tinted water until it will absorb no more, and then mixing thoroughly.

6. With the fingers, preferably, flip the mixture against the clay, covering the pattern with a thin coat of colored plaster about the thickness of a silver dollar. Be sure every portion of the pattern is covered, and there are no air bubbles. Blow the plaster in crevices where there are likely to be air pockets.

7. The surface of this coat can be left rough so there will be no danger of it separating from the white outer coat of plaster when the clay pattern is being removed.

8. Some prefer to brush the tinted plaster with a thin coat of clay slip, so the outer coat will come away from it when the mold is being chipped off the plaster cast.

9. Next mix about ten times as much untinted plaster as was required for the tinted coat (Operation 13, Method 2).

10. Apply the plaster as before to a depth of ¾ in. or more, depending on the size of the mold. Leave the top edge of the dividing wall exposed.

11. Cover the wet surface of the plaster with scraps of burlap, or if necessary, small sticks, iron rods, or pieces of wire, where reinforcement is needed, keeping clear of the dividing walls. Smear these pieces with enough plaster to hold them in place.

12. When the plaster hardens, separate the mold parts at the dividing walls by tapping gently with a chisel if the mold is of more than one piece.

13. Soak the mold, with the pattern inside, in a tub of water.

14. Remove the clay figure or pattern, being careful not to scratch the inside surface of the mold.

15. Wash the mold clean with a soft wet sponge.

16. For making a plaster cast, as is usual with this type of mold, the inside surfaces must be made nonabsorbent, after which they cannot be used for slip casting. To do this, either apply soap size (Operation 12) or a coat of waterglass (sodium silicate).

17. Fit the parts of the mold together, if the mold is of more than one piece, and bind them securely with wire or twine. Seal the joints with plaster.

Fig. 70. Flexible molds.

Operation 18

MAKING FLEXIBLE MOLDS

Molds made of flexible materials are particularly adapted to modeled work, especially where the problem of difficult undercuts and returns has to be met.

Of the various materials used in making flexible molds, such as beeswax, gelatine, glue, treated rubber, and the like, the latter is by far the simplest to use, and the more certain of satisfactory results in the hands of the amateur. The casts are confined to plaster of paris, or other quick-setting materials. Ordinary clay cannot be used as rubber will not absorb the water in the slip. Molds are made of the various types of this material on the market as follows:

1. Place the figure or other pattern to be duplicated on a flat surface.

2. Fill a soft brush with soapsuds, gently wiping off the surplus. If this is not done, it will be impossible to properly clean the brush after using the liquid rubber.

3. Dip the brush in the liquid rubber and anchor the piece to the surface on which it stands by drawing the brush around the base so that the liquid is on both surfaces.

4. Give the surface of the figure a coat of liquid rubber, taking care to get it in all the crevices without leaving any air bubbles.

5. In a few minutes, as the coat becomes dark and transparent, apply a second coat.

6. Repeat this process once or twice more and clean the brush.

7. The liquid rubber is used for the inner layer of the mold to insure a good smooth surface. To hasten the building of the mold and to strengthen it, treated rubber in the form of a paste is now applied to the dried surface. Smear the material on with a spatula.

8. After one hour, apply a second coat of the paste.

9. Continue, allowing one hour between applications. When the mold is of sufficient thickness to support the cast to be made in it, apply a few coats of liquid rubber as in step 4, to toughen the surface of the paste.

10. Do not remove the pattern until the rubber mold has dried 24 hours. In most cases the mold will be found flexible enough to slip

over the inequalities of the pattern. It will then return to its original shape (see Fig. 70).

In the case of very elaborate pieces, or anything tall like a candlestick, it may be found necessary to cut the mold open down one side only. This may be done with a very sharp knife or scissors. Before filling the mold, the edges should be placed together accurately, and held in place with adhesive tape.

For casting directions see *b*, Operation 24.

CHAPTER VII

CASTING AND PRESSING IN HAND MOLDS

Operation 19 (Project 5, p. 18)

SLIP CASTING

Slip casting in plaster molds is a common method used in making commercial pottery, especially for light ware.

1. Wipe the inside of the mold with a damp sponge.

2. Assemble the mold, and tie it securely with wire or twine. Heavy rubber bands may be used for small molds. Strong bands can be made by cutting off 1-in. sections of an inner tube.

Fig. 73. Slip casting.

3. Prepare a thick creamy slip (Operation 1).

4. Thoroughly stir the slip, and run it through a fine (No. 60 or 80) sieve. Fill the pouring vessel, which should hold enough to fill the mold at one pouring.

5. Pour the slip carefully into the mold until full (Fig. 73). Rock

Fig. 74. A modeled figure cast in three parts and joined with clay slip.

or jar the mold to prevent air bubbles. As the slip settles, pour in more to keep the mold full. If the mouth of the mold is small, a funnel can be used.

6. The plaster, being porous, absorbs the water in that portion of the slip lying next to it, thus leaving a solid deposit of clay on the inside of the mold. When this deposit has reached sufficient thickness, carefully invert the mold and pour out the remaining slip.

7. Place the mold upside down on the table, on two parallel sticks, to drain.

8. After 24 hours, carefully pry open the mold and remove the cast shape.

9. Finish carefully (Operation 23).

10. Store the mold in a warm place.

Operation 20 (Project 6, p. 19)

PRESSING HOLLOW WARE WITH SLABS

When a piece is too large to slip cast satisfactorily, or if speed in emptying the mold is a factor, it may be pressed in the following manner. Slab pressing can be done in slip molds or in some piece molds for modeled figures.

1. Separate the mold, laying the parts face up on the table.

2. Roll out a clay slab (Operation 3) large enough to cover the inside surfaces of the mold. Polish the top surface of the slab with a palette knife.

3. Dust the inside surfaces of the mold with a little powdered chalk.

4. Cut pieces from the clay slab to fit roughly each part of the mold.

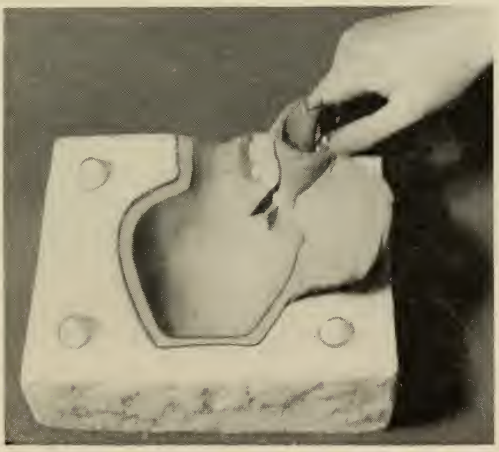

Fig. 75. Pressing hollow ware with clay slabs.

5. Lay the clay pieces on the inside surface of the parts, polished side down, and pat each down carefully with a damp sponge.

6. Trim off the projecting clay, being careful not to harm the edges of the mold (Fig. 75).

7. Bevel the edges of the clay with a small stick, so that there will be a narrow V-shaped crack on the inside where the parts join, after the mold is assembled.

8. Assemble the mold, and tie with twine or wire.

9. Roll out some thin ropes of soft clay.

10. Wet the V-shaped cracks with clay slip.

11. Press the ropes of the clay firmly into the V-shaped cracks, smoothing them with the fingers, or, if necessary, with a sponge or felt fastened on the end of a stick.

12. After the clay dries for several hours, carefully remove the mold.

13. Finish carefully (Operation 23).

Operation 21 (Project 7, p. 19)

PRESSING TILES, SMALL FIGURES, ORNAMENTS, AND APPENDAGES

1. Dust the mold with a little powdered chalk.

2. If a one-piece press mold is being used, simply press the clay, a small piece at a time, firmly into the mold with the fingers until it is full. Scrape off the surplus clay with a straight stick or taut wire. Some pieces can be lightened by hollowing out from the base with the fingers before removing from the mold.

3. If a simple two-piece squeeze mold is being used (Fig. 64), lay a piece of clay slightly larger than the article to be pressed in the form of one of the halves of the mold.

4. Press the other half of the mold down on the clay. Be sure the joggles fit.

5. If the halves do not go clear together, remove the surplus clay in the U- or V-shaped grooves, and press again. Add clay where there is not enough.

6. If the shape of the mold is such that the clay will not reach every part by this method, fill each half as directed in step 1 for a one-piece press mold.

7. Rub a little clay slip on the exposed surfaces, and press the halves firmly together.

8. A small, pressed piece can often be taken from the mold immediately, but if the clay is too damp or the shape of the mold is such that it is impossible to do this, leave the piece in the mold until it is stiff enough to handle.

9. Finish carefully (Operation 23).

Operation 22 (Project 8, p. 20)

PRESSING FLATWARE IN A HAND MOLD

1. Roll out a well-pounded slab of clay on a cloth a little larger and thicker than the plate or dish to be made (Operation 3). Smooth and polish the surface with a palette knife.

2. Slip the left hand under the cloth, lift the slab, and place it on the bottom half of the mold, cloth side up.

Fig. 76. Pressing flatware on a hand mold.

3. Carefully remove the cloth.

4. Pat the clay with a felt dabber or soft, damp sponge, working from the center to remove air bubbles.

5. Trim the surplus clay even with the rim of the plate.

6. Press the top half of the mold down firmly on the clay, making sure that the joggles engage properly (Fig. 76).

7. When the clay has become sufficiently tough, remove the top half of the mold, and turn the piece out in the hand.

8. Flatware must be dried slowly and carefully. The rim will tend to dry faster than the base. To prevent this, run a wet brush around the edge as needed.

9. When the piece is dry, round the sharp edge of the rim with very fine sandpaper and smooth it up with damp finger.

Operation 23

FINISHING CAST AND PRESSED WARE

Finishing should be done as soon as the clay is tough enough to handle.

1. Cut off any waste at the top with a knife.

2. Moisten and round the rim carefully with the fingers.

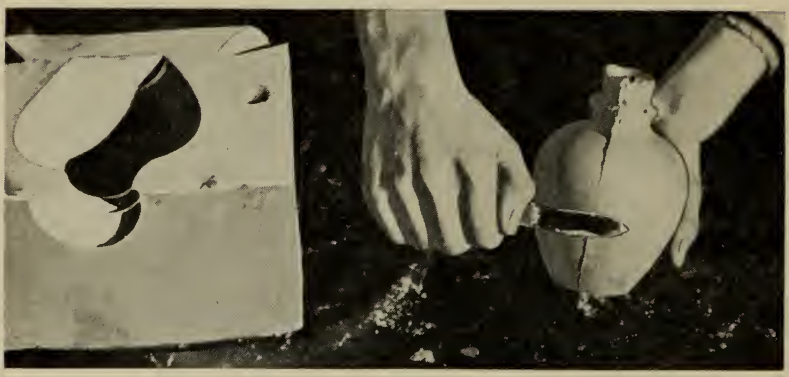

Fig. 77. Fettling or scraping off mold marks or cast lines.

3. *Fettle* or scrape off the cast lines or mold marks with a knife (Fig. 77), and smooth down with a wet finger.

4. Fill up and smooth depressions and air holes with some of the waste clay dipped in clay slip.

5. Wipe the surface carefully with a soft, damp sponge. Circular pieces can be centered on a wheel or whirler which is turned or whirled with the left hand, the sponge being held lightly against the shape with the right.

6. Attach appendages or ornaments, if any (Operation 10).

7. When leather-hard, some clays can be rubbed with the hand until smoothly polished.

8. When dry, a piece can sometimes be improved by using very fine sandpaper to smooth rough surfaces and uneven places.

9. Scratch the date, name, etc., as desired on the base.

Operation 24 (Project 9, p. 20)

MAKING PLASTER CASTS

Making plaster casts is not a pottery process, but the process is related because it is used to make permanent, clay figures, which, because of firing problems, would be difficult to preserve in the regular way. They are cast in molds made of plaster or flexible materials as follows:

a) Casting in Waste Molds

1. The sooner a waste mold is used, the easier it will be to chip or remove from the plaster cast. See that the inside surface has been sized (Operation 17, step 16).

2. If the mold is of more than one piece, fit the parts together, bind them securely with wire or twine, and seal the joints with plaster.

3. In estimating the amount of plaster required for the cast, keep in mind that only very small pieces are cast solid. The plaster of hollow casts is usually from ½ to 1 in. thick, depending on the size of the figure. However, in making larger casts it is best to mix the plaster in two or three lots so that it will not set up in the mixing jar before the first layers have stiffened sufficiently to receive the remainder. Mix the plaster by either method described in Operation 13, stirring carefully to avoid air bubbles.

4. Pour the plaster a little sooner than is customary in making pottery molds, filling the waste mold about one-third full.

5. Tip and shake the mold around until all the inside surface is covered with plaster. It is important that there are no air bubbles. If possible, blow the plaster into crevices where there are likely to be air pockets.

6. As this layer and those that follow stiffen, repeat the process until the plaster has built up sufficient thickness. Mix more plaster when necessary. When making large casts, press scraps of burlap in the soft plaster for reinforcement before the last coat is given.

7. When the plaster has set at least one-half hour, remove the white outer mold by chipping as shown in Figure 78. This is best done with a mallet and an old chisel, the edges and corners of which have been rounded. If the plaster in the cast has not set up hard enough, the cast is liable to be broken. On the other hand, if the waste mold

is allowed to stand too long, it is more difficult to chip, and again the cast is liable to be broken. Chisel off the mold reinforcements first. Great care must be used or the cast may be ruined. Hold the chisel by the blade with the ball of the hand resting on the plaster. If the mold breaks with the chisel held in this manner, the cast is less likely to be harmed as there is a slight recoil of the chisel when it is struck by the mallet. This is especially important when removing the inner layer of tinted plaster. This layer acts as a warning that danger lies ahead. When the color appears, the chisel is very near the plaster cast.

Fig. 78. When chipping a waste mold from a plaster cast, it would be safer to rest the ball of the hand on the plaster.

8. To remove the colored plaster, do not run the chisel between it and the cast in an effort to separate them. Hold the chisel at right angles to the plaster, grasping the blade firmly between fingers and thumb, the ball of the hand resting on the plaster. Tap the chisel lightly with the mallet. If the mold was properly sized, the tinted layer will easily come off the larger surfaces. Sometimes large pieces can be picked off with the finger. Special care, however, must be given the more delicate portions of the cast.

9. Patch up any scratches or chips with soft plaster, first wetting that portion of the cast to retard the setting until the surface can be smoothed up properly with the fingers or modeling tool. If the patch sets too soon, use very fine sandpaper as a last resort. Rejoin broken

pieces with soft plaster or waterglass, first soaking the surfaces with water.

10. Finish the cast with colors if desired, after it has thoroughly dried as directed in section (*c*) of this Operation.

b) Casting in Flexible Molds

1. Cover the inside surfaces of the mold with either a half-and-half mixture of glycerine and water, or with soap size. Do not use grease or oil as it will eventually destroy the mold.

2. Support the mold in position so that the open part, which will be the base of the finished cast, is in a horizontal position.

3. Fill the mold with plaster (Operation 13) or other quick-setting material, jarring to prevent bubbles.

4. Scrape off the excess plaster at the opening of the mold with a straight stick.

5. Let the cast harden for several hours before removing the mold so there will be no danger of breakage.

c) Finishing a Plaster Cast

A plaster cast may be left uncolored, shellacked, or waxed, if desired, but as plaster is rarely sought as an end in itself, usually some imitative surface treatment is given to produce the effect of the more orthodox materials of the sculptor.

What is called a French polish can be given the white plaster by applying several thin coats of an equal mixture of alcohol and white shellac, allowing at least a half hour between coats to dry, and polishing with a soft cloth and French chalk. The details and hollows can be darkened by covering the whole surface with chrome yellow or raw umber mixed with spirits and a few drops of shellac, and the high lights brought out by rubbing with a soft cloth as described for bronzing on page 106. The cast is finally waxed and polished.

Sometimes waxing and polishing alone is sufficient to satisfy the modeler. Several coats of furniture wax or an equal mixture of beeswax and turpentine are applied to the warmed cast, each being brought to a high polish before applying the next. In melting the wax and turpentine, guard against possible fire.

In applying light finishes, the plaster must be clean and in all cases thoroughly dried. The least moisture will cause the finish to scale. An overnight soaking in a tub of water will generally remove

fingerprints, but must be followed by a week's drying in a warm place. Large pieces require considerable time. A quicker method is to brush the surface with a coat of hot starch. When this cools it will peel off, taking the dirt with it. Very soiled cases are sometimes given several coats of boiled linseed oil which imparts an even, mellow finish.

Darker colors, of course, and bronzing powders can be used if desired. These are usually applied on a base of shellac. A common method of imitating the appearance of a bronze casting is as follows:

1. Make a mixture of a small amount of shellac and an equal amount of alcohol.

2. Give the cast a thin coat of the mixture as quickly and at the same time as carefully as possible. If there are runs, correct them immediately but do not go back over surfaces that have been shellacked for more than a few seconds.

3. Clean the brush in alcohol immediately.

4. Let the cast dry for a half hour.

5. Put a small amount of the cut shellac in a shallow dish and mix in some bronzing powder with the brush.

6. Give the cast a thin coat of the bronze mixture, taking the same precautions as in the first coat. Dab the crevices first and the larger plane surfaces last. Stir the powder from the bottom with the brush each time it is dipped in the liquid. Sometimes it is possible to place the surface being coated in a horizontal position to prevent runs and sags.

7. Clean the brush as before, and let the coat dry at least an hour before applying the next.

8. Brush on a second thin coat of bronze.

9. To kill the cheap glitter and to give a softer antique effect, cover the whole surface with a thin coat of oil or spirit color, such as Van Dyke brown, black, or dark green, and rub up the high spots with quick swipes with a soft cloth pad. The color will hold better if applied while the last coat is still tacky.

10. Wax the cast and let it stand overnight.

11. Polish the surface, preferably with a soft brush, making quick, light strokes.

If the effect of the coloring is unsatisfactory, more may be added as before.

Another method of applying bronze is to dust the dry powder on the size while it is still tacky, with a small wad of cotton. Cut varnish, banana oil, and japan drier are also used as a bronzing liquid.

CHAPTER VIII

WORKING ON THE POTTER'S WHEEL

The invention of the potter's wheel is lost in antiquity. Its earliest form was probably a circular board made to revolve horizontally on a pivot by one hand while the soft clay upon it was shaped by the other. Later forms employed the use of devices which enabled the operator to turn the wheel with his foot, and early pictures on Egyptian tombs show wheels turned by assistants by means of an auxiliary wheel, with a crank, connected to one on the spindle by a rope belt. A common form of the potter's kick wheel which has been in use for centuries is simply a vertical spindle with a horizontal disk, or wheel head, on the upper end to work on, and a heavy three-foot flywheel at the base which is pushed around by the swing of the foot. Today we have power-driven wheels. These are usually equipped with some means for easily controlling the speed to suit the particular part of the work which is being done by the operator or *thrower.*

Two very easily made wheels, one driven by foot power and the other motor driven, are described in Chapter I. Several modifications of the simple wheel head can be made which increase the range of its use. It can be provided with some contrivance, such as joggles — raised knobs or ridges — or a tapered flange or ring, to prevent plaster bats or jigger molds from slipping. A jiggering attachment is described in Chapter IX. An upright board of soft wood, fastened back of the wheel, is necessary as a support for the sharp end of the turning stick used when a piece of ware is being shaved (Operation 27). A helpful attachment is a diameter and height gauge which consists of a set of three horizontal sticks fixed on a hinge at one side of the wheel (see Figs. 5 and 90). The points of these adjustable sticks are set at the important surface points, either on a template or a pattern, and then swung out of the way. From time to time they are swung back to the work on the wheel to serve as a check or guide in getting the correct dimensions.

Operation 25

CASTING A WHEEL BAT

The use of a bat on a potter's wheel (Fig. 81) not only simplifies for beginners the removal of the piece while the clay is yet soft, but absorbs part of the extra moisture usually found in the base. Its use is also convenient when work on the piece must be temporarily halted and the wheel is needed for others. The experienced thrower usually works directly on the wheel head.

1. Make a circular hoop 8 or 10 in. in diameter with a piece of 1½-in. belting, linoleum strip, cardboard, or other flexible material.

2. Lay the hoop in the center of the wheel head which should be provided with joggles (Fig. 107) or other contrivance to keep the bat from slipping. Hold the hoop in place with a rope of soft clay pressed firmly around the outside, completing the form.

3. Size the wheel head within the form (Operation 12).

4. Mix and pour plaster to fill the form (Operation 13).

5. As soon as the plaster sets, remove the form.

6. Push the point of the turning stick into the board support back of the wheel at a point level with the top of the bat, holding the stick to your left with the left hand.

7. Start the wheel with the right side moving away from you.

8. Hold a straight-edged turning tool in the right hand, and, bracing

Fig. 81. Plaster wheel bats.

the wrist against the stick, move them together in such a manner that the edge of the tool will shave the top of the bat level or slightly convex as desired.

9. True up the rim of the bat, holding the tool near the edge and cutting straight down.

10. Do not attempt to remove the bat until the plaster has set hard.

Operation 26 (Project 10, p. 21)

THROWING ON THE WHEEL

To become a successful *thrower* requires considerable practice, and the beginner should not be discouraged if his first attempts result in failure. Throwing, once learned, is intensely fascinating, and the ware produced is more valuable than that made by other methods. First, a small bowl or vase of simple lines should be designed (Operation 5) and a template made for it (Operation 6). If the wheel is equipped with measuring sticks, they should be set according to the template and swung out of the way. They should be used to check the dimensions from time to time as the work progresses.

a) Preparing the Wheel

1. Sponge one of the round plaster bats made for the wheel with clean water.

2. Run out a thin layer of clay slip on the wheel head.

3. Firmly press the bat over the joggles on the layer of slip. If the wheel has no joggles or other contrivance to prevent slipping, it will be necessary to center the bat carefully. If you are going to work directly on the wheel head without using a bat, the above instructions, of course, are disregarded.

4. Place a jar or basin of water, a soft sponge, ribs of various shapes, and a piece of fine brass wire to the right of the wheel.

b) Centering a Clay Ball

1. Wedge a ball of clay (Operation 2). If several similar pieces are to be thrown, make ready as many clay balls, uniform in size, as needed. Beginners in their first attempt should use a ball of clay no larger than a baseball.

2. Start the wheel revolving with the right side moving away from the operator.

3. Throw the clay ball on the wheel as near the center as possible.

4. Wet the hands.

5. Brace both forearms on the rest, holding the hands rigid.

6. With the thumbs together, gradually but firmly press the palms against the sides of the clay ball forcing it to the center. Sprinkle a

little water on the clay with the right hand if lubrication is needed.

7. Let the clay rise in the form of a cone as it is squeezed (see Fig. 82).

8. Bring the hands over the top. With thumbs together, press down again, keeping the hands rigid at all times.

9. Repeat spinning up and pressing down until all irregularities in the clay disappear. This step, known as *mastering* the clay, improves its texture and strength.

Fig. 82. Centering the clay ball on the wheel.

c) *Spinning Up a Clay Cylinder*

1. While steadying the clay with both hands, with the forearms braced firmly against the rest, slowly flatten the cone of clay into a low cylinder.

2. Press the thumb of the right hand slowly into the center of the cylinder, down to within about ½ in. of the plaster bat, and then out from the center toward the edge, as far as is called for in the design (see Fig. 83). The beginner will need to check the thickness of the base with a wire or broom straw. The clay wall will rise in the hand between the thumb and the forefinger. All movements should be slow and gradual. Lubricate sparingly with water and only when necessary.

Fig. 83. Starting to raise the walls on the wheel.

3. On the near side of the revolving shape, slightly pinch the wall next to the base with the thumb of the left hand on the outside, and the forefinger on the inside, steadying the whole with the thumb and forefinger of the right hand, which is turned palm up, the back of the wrist being steadied on the rest (Fig. 84).

Fig. 84. Spinning up the cylinder.

4. Gradually raise both hands to the top of the cylinder without changing the relative position of the fingers. Repeat this operation until the cylinder is as high as can be made in this manner. These different hand positions and the ones that follow are known as *potter's grips*.

Fig. 85. Shaping up the walls of a thrown vase with a rib.

5. On the inside, level and square the bottom by rigidly holding the square end of a rib or a stick against the revolving clay.

6. Insert the left hand inside the cylinder, holding the thumb side of the second joint of the forefinger against the right-hand side of the revolving wall. At the same time, hold the second joint of the forefinger of the right hand against the outer side of the wall to oppose the finger on the inside. A rib may be used as is shown in Figure 85.

7. Raise both hands gradually to the top of the cylinder, keeping the fingers a definite distance apart. Avoid getting the lower part of the wall too thin before the top is pulled up. Repeat this operation with the fingers a little closer each time, until the walls have reached the desired height and thickness. This is called *knuckling up*.

8. If the walls have spread, lightly grasp the shape with both hands on the outside near the base and press slightly, raising the hands at the same time.

9. Repeat steps 6 and 7, truing up the cylinder. If the top is irregular, cut it off square while the wheel is turning by rigidly holding a short awl or *pricker* or a piece of taut wire or string against it. A

Fig. 86. Widening the walls of a thrown cylinder.

fine brass wire stretched in a coping-saw frame is a handy tool for this purpose. Quickly lift off the waste the instant it becomes free. If the cylinder becomes very irregular or lopsided, it is usually better to begin again with fresh clay. The irregularities may have been caused by using insufficiently wedged clay, clay of uneven texture, or clay that is too wet. It also may be caused by bringing the fingers together or upward too rapidly or by an unsteady arm. Determine the cause and try to avoid it in the next attempt.

d) Shaping the Walls

1. Insert the left hand inside the cylinder, holding the thumb side of the second joint of the forefinger against the right-hand side of the revolving wall at the bottom. At the same time, hold the second joint of the forefinger of the right hand against the outer side of the wall to oppose the finger on the inside.

2. Gradually force the wall outward (Fig. 86) or inward (Fig. 87) according to the design, beginning at the bottom and going slowly upward. Keep the hands rigid and the fingers a definite distance apart.

3. A short sharp curve can be made by placing the joint of the forefinger of the left hand slightly above that of the right, and pressing gently outward, or by placing the joint of the forefinger of the right hand a little above that of the left hand, and pressing gently inward.

4. A long inward curve may be made by gently pressing in on both right and left sides of the shape at the same time with both hands. The balls of the thumbs and middle fingers can bring pressure at four equidistant points on the circumference. The shape may also be steadied and *lopsidedness* corrected in this way.

Fig. 87. Narrowing the neck of a thrown vase.

5. Shape the neck, mouth, and lip with the fingers (Fig. 88) as desired. A narrow rib or tool may be used if necessary (Fig. 89). If the clay becomes too soft at any time, the work can often be saved by letting it stand an hour or so before proceeding.

6. Scrape the waste clay from the revolving bat or wheel head up to the edge of the base with a rib. If the walls curve under to a narrow base, hold either a three-cornered shaving tool or a pointed rib in the angle.

Fig. 88. Shaping the lip of a small thrown vase.

e) Finishing

1. Clean out the inside of the revolving shape with a soft, damp sponge, or, if the mouth is narrow, with a sponge tied on a stick.

2. Lightly smooth the outside with a soft sponge. Ridges may be removed by holding a *rib* of wood, metal, bone, stiff rubber, or slate against the sides of the revolving shape, as is shown in Figure 91. If

Fig. 89. Shaping the mouth of a thrown vase with a rib.

Fig. 90. Throwing a duplicate vase, using gauge sticks.

ridges are desired, however, they can be made by holding the first two fingers of the right hand against the clay, backing them up on the inside with the side of the left forefinger.

3. Stop the wheel. Gently pry the bat loose from the wheel head without touching the shape, and set it on the drying shelf. If the piece has been made directly on the wheel head, cut it off with a piece of fine wire. Holding an end of the wire in each hand, push it across

Fig. 91. Smoothing up a clay surface on the wheel with a rib.

the face of the wheel head under the base. Lightly lift the piece with the palms of the hands placed as close to the base as possible.

If the walls are too thick or too rough, the shape should be turned or shaved when *leather-hard* (Operation 27). The base can also be improved by turning.

f) Throwing in Sections

If a shape is too large to be thrown in one piece, it is thrown in sections.

1. Make a design (Operation 5), cut a template of the desired shape (Operation 6), and mark where the sections are to be joined. Cut the template horizontally at these marks, making a template corresponding with each section to be made.

2. Shellac the face of a bat so the work will be less liable to come loose, and place it upon the wheel.

3. Start the wheel, and throw the bottom section right side up (Fig. 92). Proceed as directed in steps *a, b, c,* and *d* just described.

4. Gauge carefully with template and calipers from time to time until the shape and size are correct.

5. Cut the top edge level and true with a wire or pricker as the clay revolves.

6. Remove the bat with the bottom section from the wheel, and place another shellacked bat on the wheel.

7. Start the wheel, and throw the section which is to adjoin the bottom section, upside down (Fig. 93). This is done so that the adjoining edges of the sections will shrink uniformly, as the top edge will dry faster than the part next to the bat. Leave about ¼-in. waste next to the bat to allow for cutting off.

8. Gauge carefully with template and calipers until the shape and size are correct.

9. Cut the edge level and true with wire or pricker as before.

10. Remove the bat with the second section from the wheel.

11. If there is a third section, it should be thrown right side up on a shellacked bat with ¼-in. waste next to the bat. A fourth section would have to be thrown upside down like the second.

12. Let all sections toughen evenly (Fig. 94). If one edge dries

Fig. 92. Throwing the bottom section of a large vase.

faster than the one to which it is to be joined, retard the drying by covering it with a moist cloth.

13. As soon as the sections are sufficiently tough to handle, place the bat with the second section on the wheel.

14. Start the wheel, and cut the section off close to the bat with the pricker.

15. Clean off the bat as it revolves, and stop the wheel.

16. Replace the section on the bat, right side up, centering carefully, and hold in place with three lumps of soft clay at the base.

Fig. 93. Throwing the inverted top section of a large vase.

Fig. 94. Top and bottom sections of a large vase ready for assembling.

17. Start the wheel slowly, and cut the top edge level and true with the turning tool.

18. Stop the wheel, and remove the bat and section.

19. If there is a third or a fourth section, cut it off and level up the edges in the same manner.

20. Place the bat with the bottom section on the wheel.

21. Wet the top edge of the bottom section and the lower edge of the second section, and coat both with a thick clay slip.

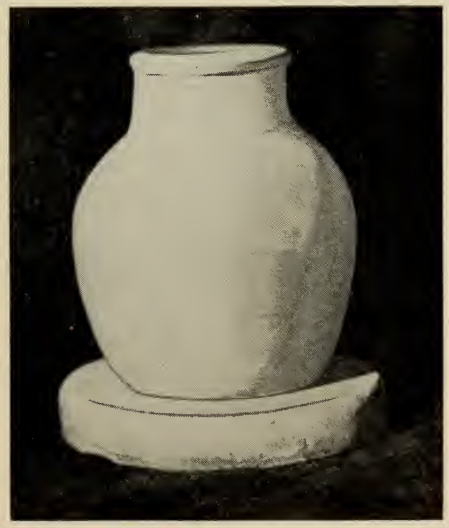

Fig. 95. Top and bottom sections of a large vase joined.

22. Place the second section carefully on the bottom section, and press down firmly (Fig. 95).

23. Start the wheel and smooth up the joint inside and out with the fingers, using soft clay to weld it together and to fill up inequalities.

24. If there are more sections to be joined, proceed in the same manner until the shape is complete.

25. Start the wheel, and soften and shape the lip as desired. Smooth off the surface with a damp sponge, and finish with a piece of damp leather.

26. If the joints are noticeable, the body will have to be shaved or turned as described at (*a*) in Operation 27.

27. Cut the shape from the revolving bat with a fine taut wire.

28. Turn the base (see *b* in Operation 27).

g) Making Lids

Lids are of two types, those with and those without a flange on the underside to prevent slipping. Those without a flange must fit into a recess around the mouth of the ware.

Lids can be made in two ways on the wheel, as well as by any of the other pottery methods, such as with coils, slabs, or slip casting, to match the type of container they are to fit.

A round flat lid without a flange, like the one shown in Figure 96, may be made right side up, flat on the wheel bat as follows:

1. Start the wheel.

2. Shape a low cone of stiff clay on the bat, making the base larger in diameter than the lid to allow for trimming.

3. Beginning at the circumference, flatten the cone to a little more than the thickness of the lid desired, pushing the surplus clay toward the center.

4. Form a knob or handle with the clay in the center.

5. Trim the edge by cutting down through the clay with a pricker or pointed tool, and smooth it up with the finger. Some experience will be required to make the proper allowance for shrinkage. Usually, when both body and lid are leather-hard, the lid should be a tight fit or be a little large, as it will shrink more in firing than the opening.

6. When the clay stiffens, shave the top if necessary (Operation 27), and remove the lid from the bat.

7. Throw a small outside clay chuck (see Fig. 97) or low cylinder on the wheel with the opening less than the lid diameter but wide and deep enough to receive the knob.

8. Invert the lid on the chuck, as shown in Figure 97, level and center carefully, and shave the upturned bottom of the piece (Operation 27) as shown in Figure 98.

Fig. 96. Making a flat-bottomed lid on the wheel.

A round flat or crowned lid, with or without a flange, can be spun inverted on the top of a clay cone, as follows:

1. Start the wheel.

2. Shape a cone of stiff clay on the bat from 5 to 8 in. across. The height, of course, depends upon whether a small or large lid is to be made (see Fig. 99).

Fig. 97. A clay chuck for shaving the bottom of a lid.

3. Form a ball of clay large enough to make the lid at the top of the cone by gradually pushing up the sides of the cone and choking it to form a neck under the ball. Do not make the neck too small at first or it will break off.

4. Steadying the clay with the left hand, shape the up-turned bottom and rim of the lid with the thumb and forefinger of the right. Form the flange with a square-cornered *rib* of sheet metal, stopping the wheel and measuring carefully when necessary.

Fig. 98. Shaving the bottom of a lid on the wheel, using a clay chuck.

5. Form the inverted top surface of the lid, the neck, and the knob with the fingers or by shaving (Operation 27). Do not try to work on the main part of the lid after the neck of the knob has been formed.

6. Allow the clay to stiffen somewhat before severing the knob from the supporting cone. This is done with the point of a pricker held in the right hand steadied against the cone, with the wheel revolving slowly. Have the left hand ready to catch the lid. If using a one-speed electric wheel, turn off the current and cut off the lid before the wheel comes to a stop.

7. Smooth up the top of the knob with a wet finger.

Fig. 99. Making a flanged lid on a potter's wheel.

h) Spinning Candlesticks

Candlesticks are spun on the wheel in much the same manner as directed for spinning a lid flat on the wheel bat.

1. Start the wheel.

2. Shape a low or medium cone of clay on the bat, depending on the height of the candlestick. The base of the cone should be a little smaller than the intended base of the candlestick.

3. Beginning not at, but about 1 in. from the circumference, flatten the cone to the thickness of base desired, pushing the surplus clay toward the center.

4. Shape up the shaft of the candlestick with the clay in the center.

5. Make the socket for the candle roughly with the fingers, and true up its sides and bottom with the square end of a narrow stick to the desired size, allowing for shrinkage.

6. Turn up the clay left at the circumference, widening and shaping it like the rim of a saucer or as desired (Fig. 30).

7. Hold a soft, damp sponge against the revolving surface.

8. Form a handle (see *a*, Operation 9), and attach (Operation 10)

Operation 27

TURNING OR SHAVING

a) *Turning the Body and Top*

If the walls of a round shape are too thick or too rough, they should be shaved or turned on the potter's wheel to the proper thickness or smoothness with a shaving or turning tool. Turning tools of various shapes can be purchased or made of stiff sheet-metal strips. The simplest type is made as follows: Cut a strip ½ to 1 in. wide by 7 in. long. Cut one end straight across, pointed, or rounded, as desired, and sharpen with a file or stone. Bend the strip at right angles 1 in. from the sharpened end like a hoe. Another type is made by looping a similar strip of sheet metal and binding the ends to a 6-in. stick or handle. The edges of the loop can be sharpened and bent in any shape desired.

1. To turn or shave on the wheel, spread a thin layer of slip on the wheel head and center a bat.

2. Start the wheel, and hold a pencil on the revolving bat at such a place that a circle will be made the size of the base of the shape or slightly larger. Stop the wheel.

3. When the piece is *leather-hard,* dip the base in clay slip, and, with the circle as a guide, center it on the bat, base down.

4. If the rim does not run true, place soft clay under the low side.

Fig. 100. A vase, stuck on a lathe faceplate, ready for turning.

If necessary, the piece can be fastened by pressing three pieces of soft clay at equidistant points around the base.

5. Start the wheel with the right side moving away from the operator.

6. Stick the point of the turning stick in the board support back of the wheel opposite or level with the place to be turned. Hold it to the right of the shape with the left hand, letting the handle extend to your left, as shown in Figure 101.

Fig. 101. Turning or shaving the body of a vase on the wheel.

7. Take a turning tool in the right hand. Rest the right wrist on the turning stick near the surface to be turned. Use a tool with a straight cutting edge for the convex portions of the surface, and one with a rounded cutting edge for the concave portions.

8. Hold the stick and tool rigid, moving both together as needed to keep the edge of the tool in contact with the surface of the clay. Hold the tool in such a manner that the clay will be cut, not scraped. If the clay is too soft the tool will jump, leaving ridges; if too hard, the surface crumbles or chatters; when it is just right, shavings should form. Hold the blade of the tool at right angles to a line tangent to the surface of the piece at the point where the clay is cut.

9. Test the thickness of the walls from time to time with the fingers, and compare their contour with the template.

10. When the walls are of the desired shape and thickness, smooth off the revolving surface with a wet sponge and finish with a piece of damp leather.

Small pieces can be turned on the lathe by sticking the base to the center of the faceplate with slip, as shown in Figure 100, and using tools as described in the making of a pattern (see *b*, Operation 14). Larger pieces may be fitted over a chuck and turned in the same manner.

b) Turning the Base

1. Start the wheel revolving with the right side moving away from the operator.

Fig. 102. Hollowing out a base on an inside clay chuck.

2. Throw a chuck of stiff clay on the wheel to fit the piece whose base is to be turned, wide-mouthed ones fitting over (Fig. 102), and narrow-mouthed ones within (Fig. 103) the chuck.

3. Stop the wheel.

4. Place a piece of cloth over the clay chuck to prevent the shape sticking to it.

5. Place the mouth of the shape over, or within, the chuck (see step 2), and carefully center it. If the base is off center when the wheel revolves, be sure to stop the wheel and readjust the shape on the chuck until it is exactly centered.

6. Start the wheel.

7. Steady the revolving shape with the left hand. With the shaving

tool in the right hand, hollow the base, and form a suitable foot or rim around the edge. Use the turning stick to steady the hand if necessary (Fig. 102).

8. Finish by holding a wet sponge against the revolving base.

9. Sign the piece with date or initials, as desired, and put away to dry.

Fig. 103. An outside clay chuck.

CHAPTER IX

PRESSING WARE WITH REVOLVING MOLDS

THE JIGGER AND THE JOLLEY

The machines known as the *jigger,* for making flatware, and the *jolley,* for making hollow ware, consist essentially of a revolving mold mounted on a vertical spindle, used in conjunction with a descending *profile* held by a supporting arm. Flatware, such as a plate or saucer, is made inverted *on* the revolving jigger mold, or inside mold, which forms the inside surface of the ware, while the descending profile, cutting the revolving clay, forms the bottom or outside surface, as

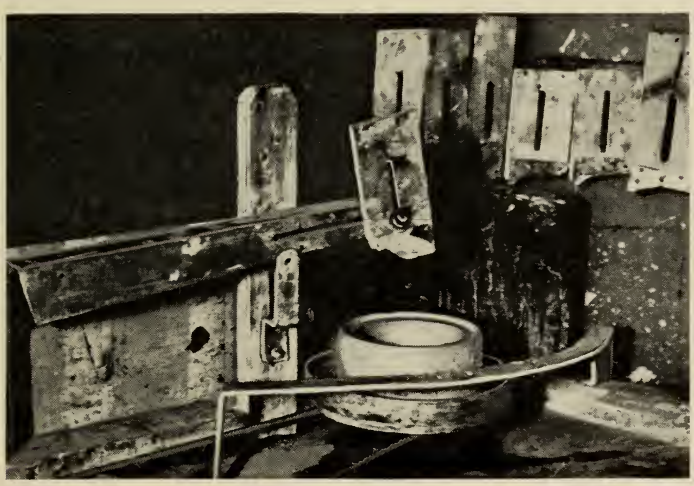

Fig. 106. A jigger attachment for a potter's wheel made in a school shop.

shown in Figure 111. Hollow ware, such as a cup or bowl, is made right side up *in* a revolving jolley mold, or outside mold, which forms the outside surface of the ware, while the descending profile forms the inside surface, as shown in Figure 112.

In the craft shop, hollow ware is preferably built up by hand, made on the wheel, or cast, and the jolley is not often used except to acquaint the student with an industrial method. It is difficult, however, to make flatware of a desirable thinness except on a jigger,

though heavier flatware can be made satisfactorily in a hand mold (Operation 22). Any craftsman, handy with tools, can convert his potter's wheel, if not already equipped with a jiggering attachment, into a combination *three in one,* wheel, jigger, and jolley, as shown in Figure 106, by constructing a hinged arm to hold the profile, and affixing to the wheel head some permanent contrivance, such as joggles (Fig. 107), or a raised flange or ring, to keep the removable mold from slipping. To insure a perfect fit and alignment, the plaster molds as well as the wheel bats used in *throwing* are cast and cut directly on the wheel head (Operations 25 and 29).

Fig. 107. A wheel head provided with joggles to prevent bats or molds from slipping.

As the amateur would not ordinarily have a jolley, but would place his hollow-ware molds on the wheel head or on a jigger, this method used either for flat or hollow ware will be spoken of as *jiggering.* See the glossary for other uses of these terms.

Operation 28

MAKING PROFILES

a) Flatware Profiles

1. On a piece of paper, design a cross section of the plate or dish you wish to make. Allow for shrinkage as usual by making the design about one eighth larger than you wish the finished ware to be. Be sure that there are no *returns* that would prevent lifting the ware from the one-piece jigger mold. As one half of the cross secton is the same as the other, reproduce it by folding the paper perpendicularly through the center of the shape and tracing. Only one half of the cross section is needed, but making a whole sketch will give a better idea of how the finished dish will look.

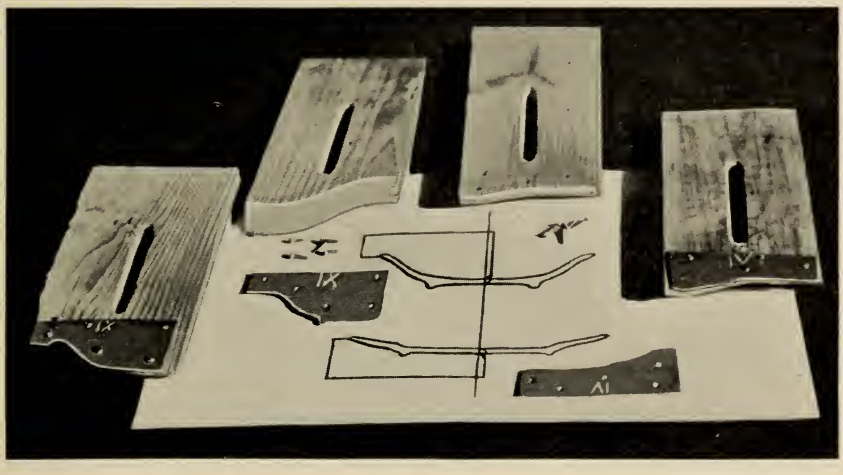

Fig. 108. Hollow- and flatware profiles for the jigger.

2. Draw a perpendicular line from the center of the base of the cross section of the dish down along the fold to a point 2½ in. below it (Fig. 108). Draw a horizontal line across the paper through this point. Draw another perpendicular line parallel to the first, beginning at the edge and drawing downward to the horizontal line.

3. In making profiles, remember that a plate or shallow dish is made on the mold, face downward. The profile of the inside or face of the shape is used only in cutting the mold, while the profile of the outside or bottom is used only in making the ware.

4. Trace these two perpendicular lines and the part of the horizontal line between on a stiff piece of sheet metal. Now trace half the inside or face of the designed shape, thus joining the upper ends of the perpendicular lines. The enclosed area will be the profile used only in cutting the mold.

5. Trace the same lines again on a different place on the sheet metal except that the outside or bottom of the design is used instead of the inside. The enclosed area will be the profile used in making the ware.

6. Cut out both profiles roughly with the tinner's snips, keeping about one-half inch outside of the straight lines but fairly close to the curved design.

7. File or grind the curved edge to the line. Make the edge smooth.

8. Cut two pieces of ⅞-in. board each about 12 in. long and slightly wider than the metal profiles.

9. Across one end of one piece lay out the contour of one of the metal profiles. On the second piece, lay out the contour of the other profile.

10. Saw to the profile line with a coping saw or jig saw.

11. Attach each profile to its board with screws in such a manner that the designed edge of the sheet metal projects about ¼ in. over and matching the curved end of the board, and so that the base of the designed dish will be at right angles to the length of the board. Be sure to attach the metal so the long side is on the left when the profile is held with the curved edge down and the metal toward you.

12. Examine the adjustable supporting arm on the jigger, and find out how the completed profile is to be attached to it. Lay out and cut a suitable hole or slot in each board for attaching it.

13. Place identifying numbers on the profiles so that they may be readily distinguished from each other, and from profiles of similar design; for example, 1*a*, 1*b*, 2*a*, 2*b*, and so on.

b) Hollow-Ware Profiles

1. On a piece of paper design a cross section of the bowl, cup, jar, or flowerpot you wish to make. Allow for shrinkage as usual by making the design about one eighth larger than you desire the finished ware to be. Be sure that there are no *returns* that would prevent lifting the ware from the one-piece jigger mold. As one half the cross

section is the same as the other, reproduce it by folding the paper perpendicularly through the center of the shape and tracing. Only one half of the cross section is needed, but making a whole sketch will give a better idea of how the finished dish will look.

2. Draw a perpendicular line from the center of the base of the cross section up along the fold to a point 2½ in. above the top of the bowl (Fig. 108). Draw a horizontal line across the paper through this point. Draw another perpendicular line parallel to the first, beginning at the edge or rim of the design and drawing upward to the horizontal line.

3. In making profiles, remember that a bowl and similar articles are made right side up in the mold. The profile of the outside is used only in cutting the mold, while the profile of the inside is used only in making the ware. The latter is sometimes made of wood and is called a *rib*.

4. Trace these two perpendicular lines and the part of the horizontal line between on a stiff piece of sheet metal. Now, trace half the outside of the designed shape, thus joining the lower ends of the perpendicular lines. The enclosed area will be the profile used only in cutting the mold.

5. Trace the same lines again on a different place on the sheet metal, except that the inside of the design is used instead of the outside. The enclosed area will be the profile used in making the ware.

6. Cut out both profiles roughly with the tinner's snips, keeping about ½ in. outside of the straight lines but fairly close to the curved design.

7. File or grind the curved edge to the line. Make the edge smooth.

8. Cut two pieces of ⅞-in. board each about 12 in. long and slightly wider than the metal profiles.

9. Across one end of one piece lay out the contour of one of the metal profiles. On the second piece, lay out the contour of the other profile.

10. Saw to the profile line with a coping saw or jig saw.

11. Attach each profile to its board with screws in such a manner that the designed edge of the sheet metal projects about ¼ in. over and matching the curved end of the board, and so the base of the

designed bowl will be at right angles to the length of the board. Be sure to attach the metal so the long side is on the right when the profile is held with the curved edge down and the metal toward you.

12. Examine the adjustable supporting arm on the jigger, and find out how the completed profile is to be attached to it. Lay out and cut a suitable hole or slot in each board for attaching it.

13. Place identifying numbers on the profiles so that they may be readily distinguished from each other, and from profiles of similar design; for example, 1*a*, 1*b*, 2*a*, 2*b*, and so on.

Operation 29

MAKING JIGGER MOLDS

a) Casting the Plaster

1. Bolt the desired mold-cutting profile on the supporting arm (see step 3 at *a* or *b* in Operation 28, and Figs. 109 and 110).

2. Adjust the stop so that, when the arm is pulled down, it will stop when the lowest point of the profile is about 2 in. above the surface of the jigger head.

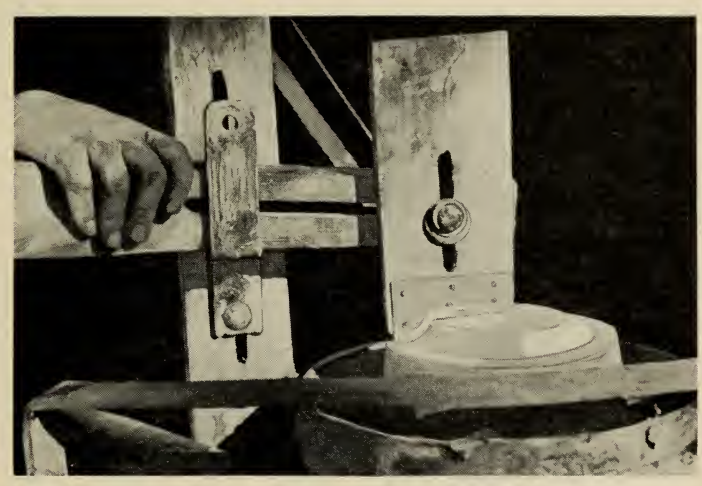

Fig. 109. Cutting a jigger mold for flatware.

3. Readjust the profile so that the point corresponding with the center of the dish will be exactly over the center of the jigger head and so the sides of the profile are perpendicular. The center of the jigger head can be easily determined by holding the point of a pencil on it as it revolves.

4. Lift the arm back out of the way until ready to cut the mold.

5. Soap size the face of the jigger head (Operation 12). The jigger head should be provided with joggles, as shown on Figure 107, or other contrivance on its face, to prevent the plaster from slipping.

6. Make a hollow cylinder of flexible cardboard or linoleum about 3 in. larger in diameter than the desired shape, and 2 in. higher. Tie twine or wire around it near the bottom and near the top.

7. Place the cylinder in the center of the jigger head, and hold it in place with a rope of soft clay on the outside at the base. Press the clay firmly in the angle, and plaster up the joints with clay so the plaster will not run out.

8. Mix and pour plaster to fill the cylinder (Operation 13).

9. As soon as the plaster sets, usually in five or ten minutes, remove the cardboard or linoleum form.

10. Cut the cylinder with the profile before the plaster becomes too hard.

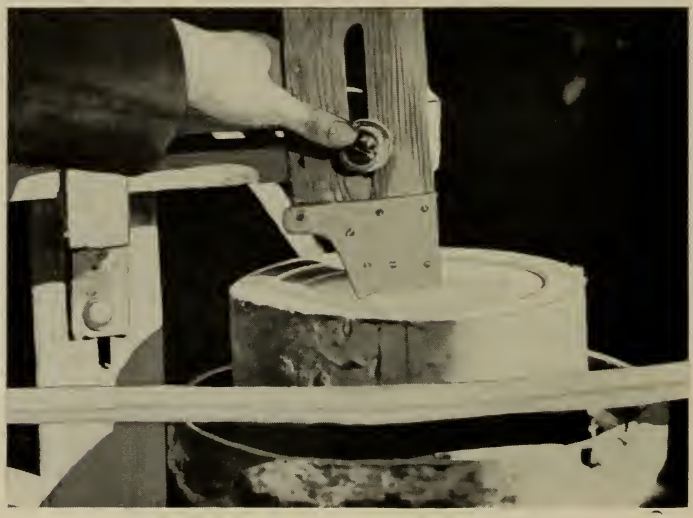

Fig. 110. Cutting a jigger mold for hollow ware.

b) Cutting the Mold

1. Start the jigger, the left side moving away from the operator.

2. Bring down the profile, gradually cutting the soft plaster, until the profile comes down to its stop. Remove the plaster from the profile when necessary (Figs. 109 and 110).

3. Lift the profile out of the way.

4. Trim the rough edges and sides wherever needed.

5. Fine sandpaper held lightly against the revolving plaster will eliminate any roughness.

6. Remove the mold from the jigger head and put it away to dry.

Operation 30

PRESSING JIGGER WARE

a) Flatware (Project 11, p. 21)

1. Place the mold on the jigger head. If the mold does not run true, place a little soft clay under the low side, and press down firmly.

2. Attach the profile of the outside or bottom of the plate or dish to the supporting arm, and adjust so that it will stop the desired thickness of the ware from the mold. The space between the profile and the mold, when the arm is down against the stop, should represent the cross section of the dish.

Fig. 111. Jiggering flatware.

3. Lift the profile out of the way.

4. Roll out a well-pounded slab of clay a little larger and thicker than the dish to be made (Operation 3). Smooth and polish the surface with a palette knife.

5. Wipe the mold with a damp sponge.

6. When the slab of clay is sufficiently tough, slip the hand under the cloth, lift and place it on the mold cloth side up.

7. Carefully remove the cloth.

8. Press the clay down on the mold with a damp sponge, working from the center outward to remove bubbles.

9. Trim off the surplus clay at the edge of the mold.

10. Start the jigger, the left side moving away from the operator.

11. Sponge the clay with water.

12. Bring the profile down and gently cut the clay as is shown in Figure 111. Sponge sufficiently to prevent sticking.

13. Lift the profile, and remove the clay as it collects.

14. Continue cutting the clay until the arm comes down against the stop.

15. Lift the profile, and stop the jigger.

16. If there are any holes or scratches in the clay, fill them roughly with soft clay.

17. Start the jigger, and smooth the surface of the clay with the profile.

18. Smooth the revolving surface lightly with the finger.

19. Carefully cut any excess clay loose from the revolving rim with the point of a knife.

20. Stop the jigger and set the mold away for the ware to dry. Run a wet brush around the edge if the rim dries faster than the base.

21. When sufficiently stiff, remove the ware from the mold.

22. When dry, round the sharp edge of the rim with very fine sandpaper and smooth it up with a wet finger.

b) Hollow Ware (Project 12, p. 22)

1. Place the mold on the jigger head. If the mold does not run true, place a little soft clay under the low side and press down firmly.

2. Attach the profile of the inside of the bowl, cup, jar, or flowerpot, which corresponds to the mold, to the supporting arm. Adjust it so that it will stop the desired thickness of the ware from the mold. The space between the profile and the mold, when the arm is down against the stop, should represent the cross section of the bowl or jar.

3. Lift the profile out of the way.

4. Wedge a sufficient amount of rather soft clay (Operation 2).

5. Start the jigger, the left side moving away from the operator.

6. Wipe the inside of the revolving mold with a damp sponge.

7. With the right hand, slap a handful of clay against the inside of the mold, and roughly plaster the base and sides with it. The hand should work on the side nearest the operator, letting the revolving clay slip between it and the mold. Be sure to eliminate all bubbles in the clay.

8. Wet the clay with the hand when necessary.

Fig. 112. Jiggering hollow ware.

9. Bring the profile down, and gently cut the clay (Fig. 112).

10. Lift the profile, and remove the clay as it collects.

11. Continue cutting the clay until the arm comes down against the stop.

12. Lift the profile, and stop the jigger.

13. If there are any holes or scratches in the clay, fill them roughly with soft clay.

14. Start the jigger, and smooth surface of clay with profile.

15. Smooth the revolving surface lightly with the finger.

16. Carefully cut any excess clay loose from the revolving rim with the point of a knife.

17. Stop the jigger, and set the mold away for the ware to toughen.

18. When *leather-hard,* remove the piece from the mold, fill up any air holes with stiff clay, and wipe carefully with a soft, damp sponge.

19. When dry, round the sharp edge of the rim with very fine sandpaper, and smooth it up with a wet finger.

Jugs, as well as vases similar to the one shown as Type 2, Figure 53, may be made by this method as follows:

1. Draw a line around the piece at its widest diameter.

2. Make separate molds and profiles for each half. The upper half must be made in an inverted position.

3. Press or jigger both halves as directed above.

4. Coat the exposed edges of the clay with slip.

5. Turn the mold of the upper half over on the mold for the lower half, fitting and pressing the halves together.

6. Let the clay toughen several hours in the molds.

7. Lift off the inverted mold and remove the ware.

In jiggering cups, the piece is often roughly spun up on the wheel (Operation 26), and then pressed in the revolving mold with the fingers, before cutting with the profile.

CHAPTER X

DECORATING AND GLAZING

Operation 31

DECORATING CLAY SURFACES

While a fine piece of pottery needs nothing more than a satisfactory glaze to complete it, often some form of tasteful decoration is to be desired. Easy designs for the beginner may consist of simple geometric forms, such as squares, triangles, circles, lines, dots, and the like, arranged in patterns. Simple conventional forms from nature, such as flowers, foliage, or birds, may also be used, or more difficult subjects may be attempted as ability increases. The decoration can be applied freehand with tool or brush, or the outline first drawn with pencil or India ink on the ware or on paper. A design first drawn or traced on thin paper may be transferred to the clay surface when the latter is either soft, *leather-hard,* or in the biscuit, according to the type of decoration to be executed. Transferring can be done by one of the following methods.

1. *On Damp Clay:* Lay the paper on the surface in the proper position. Go over the outline with a pencil, thus impressing the design on the clay.

2. *On Dry Clay or Biscuit:* Go over the outline on the paper with a very soft pencil. Then place the design face down on the surface. By carefully rubbing the back of the paper with the fingers, the outline will be transferred in reverse to the clay or biscuit. A pencil or India ink can be then used to retrace the outlines more clearly. Ink or pencil lines disappear in the firing.

3. *On Biscuit:* Place a piece of carbon paper under the design and lay both in the proper position on the surface of the biscuit. Go over the outline with a pencil. Remove the paper and retrace the outlines more clearly with pencil or India ink.

The common types of decoration are known as (*a*) incising, (*b*) inlaying, (*c*) sgraffito, (*d*) embossing or modeled decoration, (*e*) slip, (*f*) underglaze, (*g*) stanniferous, and (*h*) overglaze painting. The first four types are either tooled or modeled, while the last are painted on

with colors, colored slip, or colored glaze. Painting is usually done on a whirler so the piece can easily be turned.

a) Incising

1. When the ware is almost *leather-hard,* cut the design in the clay with an incising tool, making a narrow trench or groove in the surface with a width and depth of 1/16 in. or more. A nut pick or a similar small blunt tool may be used. Use care in removing shavings, waiting until the clay is dry, if necessary.

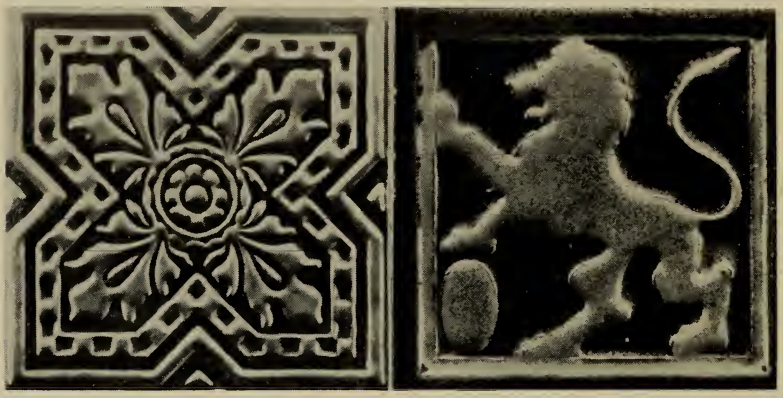

Fig. 115. Incised tiles.

2. If desired, the design may be made to stand out in relief by excavating the background with a modeling tool to a uniform depth (see Fig. 115); or, if preferred, the opposite effect may be produced by excavating the details of the design and leaving the background.

3. Slightly round all sharp edges with a moist camel's-hair brush so the glaze will not become too thin at these points.

Designs are sometimes stamped in the soft clay with dies which can be made of burnt clay, plaster, wood, or metal. This is a useful method for repeating small designs in geometric patterns.

b) Inlaying

1. As soon as the ware is tough enough to handle, excavate the portions of the surface to be inlayed to a depth of about one third of its thickness, but in no case more than ¼ in. Keep the sides and corners of the depression square.

2. Cut a piece of colored clay of similar consistency to fit one of

the depressions. Various colored clays found in nature may be used if the shrinkage is near that of the clay used in the body, or underglaze colors or metallic oxides may be mixed with the clay (1 to 10 per cent) to color it. Clay slip and glazes are colored in the same manner. Blue is produced by cobalt; yellow, red, and brown by iron; green by copper or chromium; and brown by nickel or manganese oxides. These and others may be purchased from craft supply houses. The resultant shades of color must be learned from experience as they undergo a marked change in firing.

3. Coat the depression with clay slip.

4. Quickly press the piece of colored clay in place.

5. Proceed in the same manner until all the depressions are filled. Another method of filling the depressions is to press the clay in, a small piece at a time, as in modeling.

6. Let the piece dry very slowly.

7. Carefully sand the surface smooth, finishing with very fine sandpaper, and finally rubbing with a moist finger.

8. After biscuit firing (Operation 35), use a transparent or clear glaze (Operation 32).

Another type of inlaying consists of filling incised lines with thick colored slip.

c) Sgraffito

1. Cover the soft clay surface of the ware with a thick coat of clay slip or *engobe* of a contrasting shade or color. Care must be taken that the liquid slip does not soften the clay and ruin the piece.

2. When it is sufficiently dry, mark out the design.

3. Before the slip becomes too dry, cut away the slip where desired so as to expose the body clay.

4. After biscuit firing (Operation 35), use a transparent or clear glaze (Operation 32).

d) Embossing

Decorations can be embossed or modeled in high or low relief (item *c*, Operation 11) either directly on the damp clay surface of the ware or separately, and then attached to the surface with slip (Operation 10). If several similar ornaments or *sprigs* are required, a

mold is made from the original (item *a,* Operation 16) in which the duplicate pieces are pressed (Operation 21).

e) Slip Painting

1. Prepare a thick slip, colored or not, as desired. Clay slip can be colored as described for clay in step 2, under *Inlaying.*

2. Apply the slip to the design on the soft clay surface of the ware with a brush of suitable size. Lines and dots may be laid on with either a fine brush or a slip tracer, an instrument similar to that used in pastry decoration. Banding or horizontal striping is done by first centering the piece on the whirler or wheel, then holding the brush against the revolving surface.

3. After biscuit firing, use a glaze. This should be transparent if a colored slip is used (Operation 32).

f) Underglaze painting

1. Prepare the necessary commercial underglaze colors.

2. Apply the colors to the design on the biscuit with soft brushes of suitable size.

3. Spray the surface with a very light coat of thin clear glaze.

4. Fire to a dull red heat (Operation 35).

5. Apply a coat of clear glaze by spraying, dipping, or pouring (Operation 32), and give the final firing.

g) Stanniferous painting

This method consists of applying special colors to biscuit which has been coated with an opaque tin glaze but not yet fired. Care must be taken to make each stroke of the brush correctly as no erasures can be made after the color has been applied. Both the glaze and the colors are then fired at one time.

h) Overglaze painting

This method differs from the preceding one in that the overglaze colors or enamels are applied after the body glaze has been fired. The colors are then hardened on by a third firing at a lower heat than the biscuit and the glost fire.

GLAZES

Glazing, as the word implies, is simply covering the body of the ware with a thin coat of glass. This not only improves its appearance and durability, but makes it nonporous, or impervious to liquids. With sufficient heat, the oxides of all metals combine with alkalies and silica to form glass. The potter takes advantage of this reaction by coating the ware with various forms and combinations of these materials such as white lead, zinc oxide, china clay, flint, feldspar, whiting, borax, soda, potash, salt, etc., and fusing them in the heat of the kiln.

The many kinds of glazes are classified in various ways, such as soft or hard, clear or opaque, gloss or matt, raw or fritted, lead or leadless, majolica, stanniferous, alkaline, etc. (For further study, consult these terms in the glossary.) Glazes used by the amateur on earthenware are commonly of the soft variety which mature at the comparatively low heats of the small muffle kiln. These can be purchased in the powdered form, ready for use, in a great variety of colors, either in the matt or the gloss finish. The beginner, perhaps, will be surer of satisfactory results if he uses these prepared glazes. He should obtain his glaze, his clay, and his colors all from the same supply house, and fire his pieces at the heats recommended by it. Later he can experiment by coloring a prepared clear gloss glaze by adding metallic oxides; by rendering it opaque by adding tin oxide; or by changing the gloss to a matt finish by adding refractory materials such as alumina or titanium oxide. The more advanced worker can grind and prepare his own glazes, using recommended receipts. The true craftsman, however, will not be satisfied until he has experienced the fascination of working out his own formulas as well and the thrill of testing his own glazes in the fire.

Preparing Glazes

In making up glazes, the materials are finely ground in water in a ball mill (a revolving jar containing porcelain balls) for about one hour. Rinsing water is then added, and the diluted materials run through a fine bronze sieve or screen, 80 or 100 mesh. The solids are then allowed to settle and the excess water is poured off. An amateur should choose a glaze that matures at a comparatively low and not too critical heat, and that does not run too freely. Two such glazes are given in the following:

1. Clear Lead Glaze, Cone 07 to Cone 1, Semi-Matt

	Parts by Weight
Zinc Oxide	13.5
Whiting	1.9
White Lead	43.5
Feldspar	10.5
Ky. Ball Clay	2.8
Delaware Kaolin	2.8
Flint	15.0

If a white opaque glaze is desired, 10 parts tin oxide are added to the foregoing base. In this glaze varying degrees of matt or gloss finish can be obtained by changing the amount of zinc oxide in the base. An increase of 10 parts produces a good matt. The removal of the zinc oxide will produce a gloss. The addition of any of the following oxides will color either the clear or the opaque glaze as indicated:

	Per Cent
Cobalt, ¼	Blue
Copper, 2 to 3	Green
Manganese, 3	Brown or lavender
Nickel, 2½	Green or brown
Chromium, 1 to 2	Green, brown, or pink
Antimony, 5	Yellow
Uranium, 10	Red
Iron, 5	Yellow

For Black, combine:

	Per Cent
Chromium	½
Cobalt	¼
Copper	2
Manganese	3

Varying kiln temperatures and conditions, the chemical composition of the glaze, and slightly varying amounts of the oxide used, will vary the color shade.

2. Opaque Alkaline Glaze, Cone 07 to Cone 05, Gloss

	Parts by Weight
Raw borax	34.40
Powdered glass	49.00
English china clay	7.55
Tin oxide	9.00

This glaze may also be treated with metallic oxides as described in the foregoing.

NOTE: Satisfactory results sometimes can be obtained by using substitutes for glaze, such as spar varnish, clear lacquer, and waterglass, applied cold, or various waxes, such as beeswax, floor wax, paraffin, and even yellow or brown shoe polish, applied hot to the heated bisque; but these should be used only when the equipment or conditions do not permit the use of regular pottery materials.

Operation 32

APPLYING GLAZES

1. Give the green ware a biscuit firing (see Operation 35), unless, for some reason, the glaze is to be applied directly to the green clay. In this case care must be taken that the liquid glaze does not soften the clay and ruin the piece.

2. Soak the prepared powdered glaze in water for several hours in a glazed earthenware jar, and then mix to a creamlike consistency. An average proportion is 1 lb. of gloss glaze to 10 oz. of water, and 1 lb. of matt glaze to 8 oz. of water. The mixture will weigh about 26 or 32 oz. to the pint.

Fig. 116. Glazing a tile.

3. Rub the glaze through a 100-mesh sieve into a second jar, using a stiff brush if necessary.

4. If desired, make a test of the glaze on small tiles before applying it to the ware. Place one test piece in a horizontal position in the kiln, and another standing on edge to determine how much the glaze will run. In glazing the face of a tile, hold the piece face down by the edges between finger and thumb, as shown in Figure 116. Dip it in, or rather on, the glaze for about two seconds. Lift quickly and reverse so the face is up. Be sure no bubbles have prevented the glaze from reaching all portions of the surface.

When dry, a gloss glaze coating should be about 1/32 in. thick. A heavier coating should be applied when using matt glazes. Their application requires much greater care, as they are less fusible and do not correct small defects during the firing process.

5. Wipe all dust from the biscuit to be glazed. If it is very absorbent, sometimes better results are obtained if the piece is wiped with a damp sponge.

6. In glazing hollow ware where there is insufficient glaze to dip the piece as described in the next step, half fill the piece with the glaze. Quickly roll it around until the inside surface is entirely covered, and then pour the glaze back in the jar.

7. Apply the glaze by one of the following methods, being guided in your choice by the equipment, the amount of glaze, and the size and shape of the ware.

a) If the shape is small, or if there is sufficient glaze, dip or plunge the piece into the glaze bath and place it upside down on supporting sticks to drain. Hold small pieces lightly between the thumb and finger. Touch only the rim and the base.

Fig. 117. Glazing a cup (Method b).

b) Pouring is another method of glazing the outside. After applying the glaze to the inside, as described in step 6, invert the shape on supporting sticks placed across the mouth of a jar (see Fig. 117), and pour the glaze around the base until the outside surface is covered. Sometimes a piece can be held with the left hand and rapidly turned, while the glaze is poured on with the right.

c) Where equipment is available, glaze may be sprayed on, the ware being placed on a whirler preferably in a draught box and revolved as the spray is applied.

d) If the foregoing methods are impracticable, for any reason, apply two or three coats of glaze with a soft flat brush, stroking it in one direction only.

8. Wipe the base with a damp sponge and touch up the rim with a brush.

9. Do not touch the piece until the glaze has dried, and then only with the greatest care.

10. Wash the hands thoroughly, especially when using glazes containing lead.

CHAPTER XI

KILNS AND THEIR OPERATION

A pottery kiln is an oven or furnace in which the ware is fired. A good one allows an equal distribution of sufficient heat with the greatest economy of fuel. There are many types of kilns, depending on the kinds and amount of ware to be burned and the degree of heat required. In the industry, they are usually built with a lining of slabs or bricks made of fire clay. Most of these kilns are circular in form, though some are rectangular.

In what is known as the updraft kiln, the flames pass through holes in the floor up, through, and around, the stacks of packed *saggers,* or around the unprotected ware, as the case may be. Passing out through apertures in the arched crown, the smoke is collected by the *hovel* or cone-shaped chimney which forms the roof.

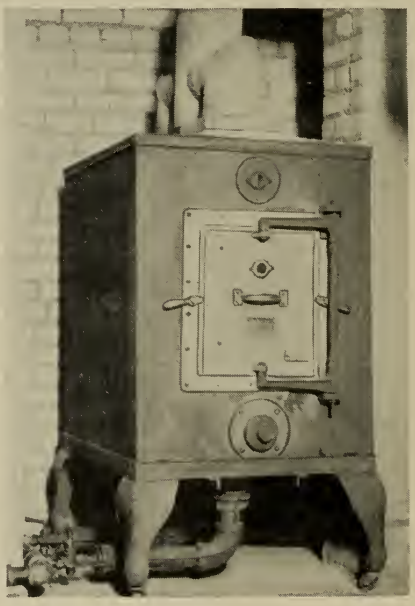

Fig. 120. A small portable muffle kiln, using gas for fuel.

The downdraft kiln is more complicated, but more economical of fuel. In a kiln of this type, the fire enters the kiln directly through the fire hole in the side where it is deflected upward toward the crown at the top by protecting flues called *bags.* The flames then pass downward through the ware and on through flues in the floor which lead to a chimney or stack outside. These kilns may have from one to a dozen fire holes, depending upon their size.

An interesting modern kiln designed for enormous quantity production is in the form of a tunnel through which a continuous string of small flat cars, holding the packed ware, slowly pass. In the central portion of the tunnel it is subjected to the intense heat of gas flames.

Another type called the *muffle kiln* differs from the open type in that the chamber in which the ware is placed is closed to the flames by walls of fire clay called a *muffle*. The flames play under, around, and over the chamber, and the ware is heated by radiation through the walls. Heavy enameled ware, such as a bath tub which could not be put in a sagger, is fired in this type kiln. The small portable kilns for school or studio use, which use gas or kerosene for fuel, are also of

Fig. 121. A small electric kiln.

the muffle type. One of these is shown in Figure 120. In these, the fuel is fed to burners placed under the muffle chamber. The flames pass up and around it, sometimes through various perpendicular flues, and on out through the flues at the top, which are fitted with controlling dampers. Portable electric kilns, like the one in Figure 121, can be bought. They are clean, easy to install and to control.

An outdoor kiln similar to the one shown in Figures 122 and 123 can be easily built at home or camp, or as a school project in masonry. Firebrick should be used, if available, for the interior walls. They should be laid up with thin joints of a mixture composed of three parts of fire clay, one part sand, and enough water to make it spread nicely. The mixture is improved by adding one-half pint of water-glass to a bucket of water. Common brick or stones and a lime-and-sand mortar can be used for the exterior which should be banked with

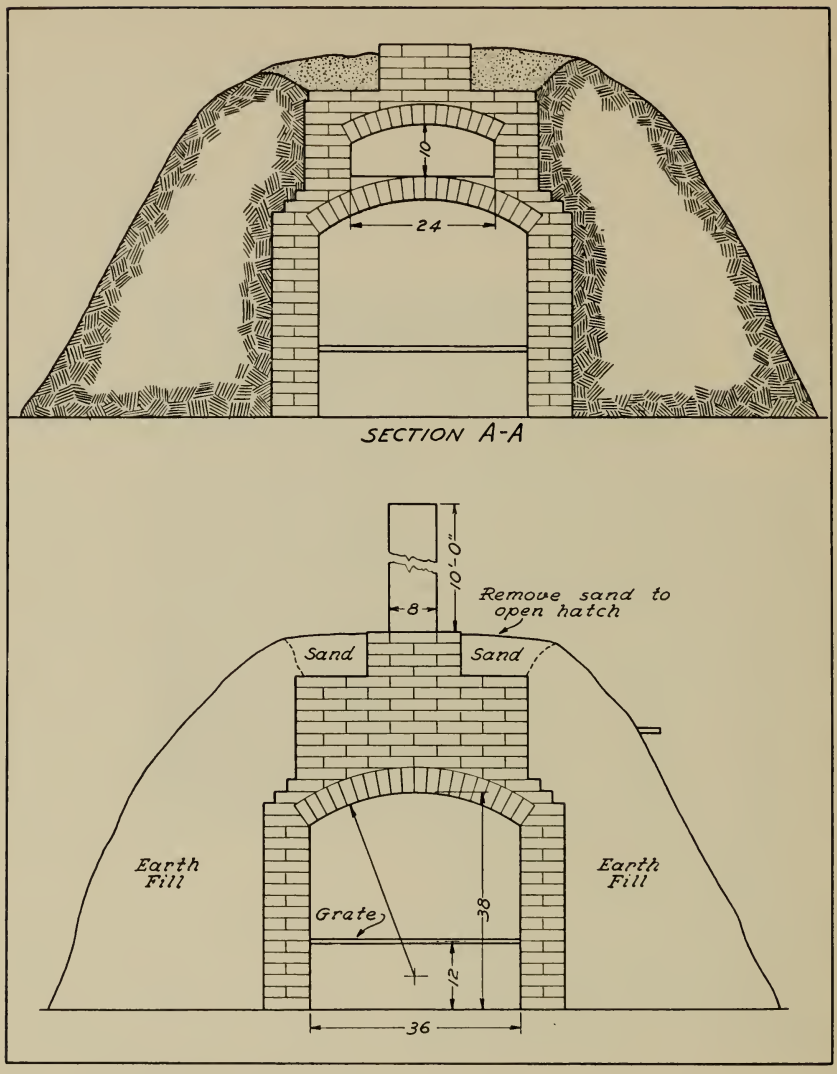

Fig. 122. Two sections of outdoor pottery kiln using wood or coal, designed for camps or schools.

dirt to hold the heat. The fire grate may be designed for either coal or wood. A muffle can be made of fire-clay slabs, or saggers may be used.

Saggers are the receptacles in which the ware is placed to protect it from the flames and smoke during the firing process (see Fig. 124). In some grades of work, or when a muffle kiln is used, saggers are not required. On account of the great heat to which they are subjected,

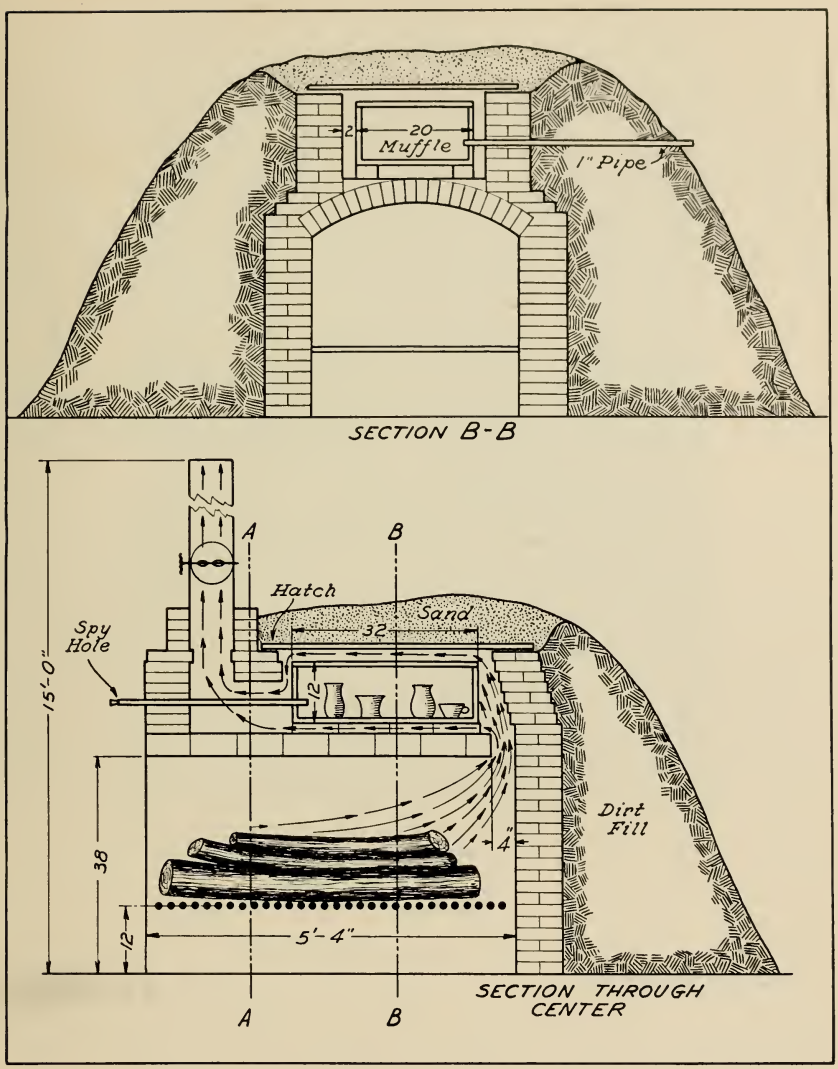

Fig. 122a. Two more sections of outdoor pottery kiln.

saggers are made of a highly refractory or infusible material which will not warp or crack easily in the fire; usually a mixture of fire clay and a *grog* made from old broken saggers ground and sifted. Broken saggers can be mended with waterglass. A stack of filled saggers in a kiln is called a *bung*. Each sagger in a bung is sealed or *pugged* by placing a rope of soft fire clay around its rim before placing the next sagger upon it.

The better grades of pottery are usually fired both before and after glazing. Pottery that has been fired once but not glazed is known as *biscuit,* and the first firing as the *biscuit fire.* The second firing, which follows the application of the glaze, is called the *glost fire.* The purpose of the biscuit fire is to render the ware more permanent and durable by first expelling the *mechanical* water, and then the chemical water in the dried clay; second, by increasing the heat of the ware until its surface is on the verge of melting; and third, by holding the heat at this point until it has soaked through all portions of the ware,

Fig. 123. A kiln using wood or coal for fuel (see Fig. 122).

producing the desired chemical combinations, making silicates and causing vitrification. The greatest shrinkage takes place in the early stages, and great care must be taken that it takes place very gradually to prevent cracking or warping. Too rapid heating will also shorten the life of the kiln. The purpose of the glost fire is to melt the glaze, and at the same time fuse it more or less to the clay body.

There should be no lack of oxygen in the flames in the glost firing, or the gases are liable to steal oxygen from the oxide in the glazes and alter their appearance. Sometimes this action, called *transmutation,* is desired in order to produce certain effects, such as the Chinese *peach bloom, pigeon's blood,* etc., in which the blue-green color produced naturally by the copper oxide in the glaze is changed to a rich red. In such cases, the *reducing* flame, as it is called, is produced by shutting off the air or introducing a piece of charcoal

Fig. 124. Saggers.

or other combustible material into the muffle in the last hour of the firing when it has reached the maximum heat.

After each firing, a kiln should be inspected. All cracks should be filled with a high temperature cement. A cement can be made by mixing fire clay with hot water to which a little waterglass — a spoonful to a pint — has been added. If any glaze has dripped on the kiln shelves or floor, it should be coated with a wash of powdered flint and fire clay.

Operation 33

PACKING THE KILN

a) *Biscuit*

1. Dust the floor of the kiln with finely powdered flint.

2. Put the shelf props or supports in position so that the ware will not have to be moved when the shelves are put in place.

3. Be sure the ware is entirely dry before putting it in the kiln. If it feels cool against the cheek, it is not entirely dry. Place the

Fig. 125. A closely packed kiln ready for biscuit firing.

heavier pieces in first, keeping them at least ½ in. from the sides of the muffle. Put small pieces inside larger ones, using a little powdered flint to prevent sticking. Fill the floor space, but do not stack the ware higher than the shelf props.

4. Place the fire-clay slabs on the props to form a shelf. Sometimes it may be necessary to put a little *wadding* — soft fire clay mixed with one fourth part sand — on the top of the shelf props to steady the shelves.

5. Fill the shelf as directed in step 3. If there is still room for more shelves, proceed as before until the kiln is full.

6. Place the proper pyrometric cones in full view of the spy hole (Operation 34) (see Fig. 125).

7. Fasten the door securely.

If the kiln has no muffle, the ware should be packed in saggers.

b) Glazed Ware

1. Make an infusible wash by taking equal parts of powdered flint and fire clay and mixing them with water to a creamy consistency.

2. Give the floor of the kiln and the shelves a coat of the wash with a brush to prevent any glaze that might drop from the ware from sticking.

Fig. 126. The kiln packed with glazed ware.

3. Put the shelf props or supports in position so that the ware will not have to be moved when the shelves are put in place. The props should reach at least ½ in. above the tallest piece of the glazed ware.

4. Place the heavier glazed pieces on stilts, at least ½ in. apart, and at least ½ in. from the sides of the muffle. Do not place any piece inside another (Fig. 126). Be very careful not to knock off any of the glaze or make fingerprints.

5. Put the shelves in carefully, place the props for the next shelf, if any, and pack as in step 4 with the lighter ware. Proceed in this manner until the kiln is full.

6. Place the proper pyrometric cones in full view of the spy hole (Operation 34).

7. Fasten the door securely.

If the kiln has no muffle, the ware should be packed in saggers.

Operation 34

USING PYROMETRIC CONES

1. Form a small slab of soft clay about ½ in. thick, 1 in. wide, and 3 in. long. If the clay has been mixed with *grog* it is not so liable to shrink away from the cones during the fire.

Fig. 127. Pyrometric cones imbedded in clay, before firing.

2. Select a pyrometric cone which melts or bends at the temperature at which the kiln is to be heated, and also one which is just below, and one just above this temperature (see Pyrometric Cone Table). Clays and glazes can be obtained that fire satisfactorily at temperatures as low as Cone 06 or 05. Find out from the manufacturer what heat is sufficient for the clay and glazes used.

3. Imbed the cones in the clay in a row in consecutive order as shown in Figure 127, and place them in full view of the spy hole and at right angles to the line of vision as shown in Figures 125 and 126.

4. Make all cones lean slightly to the right or all to the left. Additional cones of lower fusibility may be used if desired. They will serve as an earlier warning that the kiln is approaching the desired heat.

5. Other sets of cones may be placed at other points in the kiln to determine any difference in temperature.

6. When the interior of the kiln approaches a bright red, observe the cones from time to time.

Melting Points of Common Materials	Color Scale	Cone No.	Degrees F.	Degrees C.	Range of Heat Treatment of Some Clay Products
	Dull red	022	1085	585	Jewelers' enamels
		021	1103	595	Over-glaze colors
		020	1157	625	
Aluminum melts		019	1166	630	
at 658 deg. C.		018	1238	670	Potters'. decorating
(1216 deg. F.)		017	1328	720	kilns, bright gold
		016	1355	735	fire, lusters
		015	1418	770	
		014	1463	795	
	Cherry	013	1517	825	
		012	1544	840	Very soft glazes
		011	1607	875	
	Orange	010	1634	890	Common red clay prod-
Silver melts		09	1706	930	ucts: bricks, drain
at 961 deg. C.		08	1733	945	tiles, flowerpots,
(1762 deg. F.)		07	1787	975	and soft roofing
	Yellow	06	1841	1005	tiles, fireproofing.
Gold melts		05	1886	1030	Colored glazes
at 1063 deg. C.		04	1922	1050	Tin glazes
(1945 deg. F.)		03	1976	1080	Earthenware biscuit
		02	2003	1095	
		01	2030	1110	Shale and No. 2 fire-
		1	2057	1125	clay products:
		2	2075	1135	bricks, sewer pipe,
		3	2093	1145	terra cotta, hard
Albany Slip		4	2129	1165	tiles for roofing and
melts		5	2156	1180	flooring, stoneware
		6	2174	1190	pottery, and soft
Commercial	White	7	2210	1210	porcelain
Feldspar		8	2237	1225	
melts		9	2282	1250	China, English bone
		10	2300	1260	porcelain, abrasive
		11	2345	1285	wheels, electrical
		12	2390	1310	porcelain, fire bricks,
		13	2462	1350	Chinese and German
		14	2534	1390	porcelain
	Bril-	15	2570	1410	Serves porcelain,
	liant	16	2642	1450	spark plugs, high ten-
	White	17	2669	1465	sion electrical por-
		18	2705	1485	celain, Copenhagen
		19	2759	1515	porcelain
		20	2768	1520	
	Dazz-	23	2876	1580	Chrome and silica
No. 2 fire	ling	26	2903	1595	bricks, fusion tests
brick melts	white	27	2921	1605	of No. 2 fire brick
		28	2939	1615	
		29	2984	1640	
		30	3002	1650	
		31	3056	1680	
No. 1 fire		32	3092	1700	Fusion tests of No. 1
brick melts		33	3173	1745	fire brick
		34	3200	1760	
		35	3245	1785	
		36	3290	1810	
		37	3308	1820	
Special re-		38	3335	1835	Fusion tests of
fractories		39	3389	1865	Bauxite, Alumina, and
melt		40	3425	1885	synthetic refractories
		41	3578	1970	
Alumina melts		42	3659	2015	

Table III. Pyrometric Cone Table. Adapted from "Relation of Heat Treatment of Clay Products to Cones, and Other Familiar Guides," prepared by Edward Orton, Jr.

7. When the cone, which indicates the finishing point, bends over and its tip touches the clay slab, shut off the fire (see Fig. 128).

8. When the cones are taken out, they may be kept for future reference when comparing results of different firings, or a drawing can be made in a kiln log book.

Fig. 128. A series of pyrometric cones after firing.

Supplementary Information

Pyrometric cones, as the name implies, are devices for the measurement of heat, which are placed in kilns to indicate the progress of the firing. They are made of mixtures of various proportions of pure clay and certain mineral fluxes, in the form of slender cones about 2½ in. high. These cones melt or bend at fairly definite temperatures (see Fig. 128). This is sometimes called *squatting* or *tiring*. They can be had in about sixty different melting points ranging roughly from 1000 to 3500 deg. F., as shown in Table III.

Operation 35

FIRING THE KILN

a) Electric

1. Pack the kiln with ware, fastening the door securely (Operation 33). If the kiln has an exposed heating element, do not place the ware on or against it. Mount the ware on stilts, if necessary.

2. Turn on the switch or plug in the socket as the case may be.

3. Most electric kilns are furnished with a temperature-control rheostat by which the current is regulated. In the biscuit firing, especially with heavier pieces, the kiln should be heated at first very gradually to drive out all remaining moisture in the ware. Increase the current from time to time. Glazed ware may be brought to the maximum heat more rapidly, but the life of the kiln will be greater if the heat is applied gradually in the early stages.

4. Turn off the kiln when the desired heat is reached. This can be determined by reading the temperature indicator or pyrometer, or by the use of pyrometric cones (Operation 34).

If the kiln is not equipped with a temperature-control rheostat, the temperature increase is automatic, and the heat attained can be governed by the length of time the current is turned on. To obtain any desired heat, consult the table furnished by the manufacturer which gives the length of time required to gain the various temperatures. Leave the current on for the specified time required for the particular heat. Never leave the current on longer than the time required to attain the maximum heat or the element is liable to fuse.

Table IV is an example of the average heating time required by some of the smaller electric kilns on the market.

Minutes	Degrees F.	Degrees C.
5	390	199
10	700	371
15	960	516
20	1125	607
25	1255	679
30	1350	732
35	1440	782
40	1510	821
45	1570	854
50	1625	885
55	1675	913
60	1715	935
70	1775	968
80	1825	996
90	1860	1016
100	1885	1030
110	1905	1040

Table IV

b) Gas

1. Pack the kiln (Fig. 120) with ware (Operation 33).

2. Read the gas meter, and make a memorandum of the reading.

3. Be sure to open the dampers. Leave the spyhole plug out the first half hour to allow the moisture to escape.

4. Close the air gates or regulators.

5. Be sure all gas valves are closed. Start the pilot lights if there are any.

6. Partly open the main gas valves until the pilot light ignites the gas coming from the mouth of the burners. Do not open the air gates at first, as a long yellow flame will warm the muffle more evenly. If the kiln is not equipped with a pilot, thrust a lighted paper through the firebox opening before turning on the gas. Keep the face away from the firebox opening. If the gas does not ignite immediately, turn off the valve and light another taper.

7. Turn off the pilot lights.

8. After the kiln has begun to warm up, admit air to each burner by opening the air regulators until each burns with a hot bluish-green flame. There should be a slight roar, but it should not burn too fiercely. Do not open the air regulators too far as the surplus of air will cause the burner to *backfire* or catch fire in the mixer. If this should occur, turn off the burner, and relight it after closing the air regulator slightly.

9. It will be necessary to experiment with the dampers to get the proper draft due to the difference in the efficiency of different flues. About halfway open will often be found satisfactory.

10. In biscuit firing, especially with heavier pieces, the kiln should be heated very gradually to drive out all remaining moisture in the ware. When a dull red begins to show in the spy hole increase the fire and open the air gates until the flame gets all the air it will take. Regulate the dampers, gradually lessening the flue opening as the firing proceeds. By the end of the first half of the firing, a full heat should be approached. Glazed ware may be brought to the maximum heat more rapidly than biscuit, but a too rapid increase may cause the glaze to crack and peel. The life of the kiln will also be shortened.

11. Look at the cones from time to time through the spy hole as the kiln approaches a bright red. When the first cone bends, prepare to hold the fire at the required heat for some time to allow it to soak through the ware. This is especially important with heavy biscuit. When the ware has received a sufficient soaking and the point of the cone indicating the desired heat touches the support, shut off the gas flow. Close the dampers so the kiln will cool slowly. The firing of a portable muffle kiln usually takes from five to ten hours.

12. Again read the meter, and record the amount of fuel used, time, condition of cones, weather, etc., in the kiln log.

13. Let the kiln cool without opening until the next morning, or until the ware can be *drawn* or removed without gloves.

c) Oil

1. Be sure all flues, fire pans, fuel pipes, etc., are clean and there is a good draft.

2. Pack the kiln with ware (Operation 33). Leave the spy-hole plug out the first half hour to allow the moisture to escape.

3. Saturate the asbestos fiber in the fire pans with kerosene.

4. Fill the tanks with kerosene.

5. Light the burners.

6. In a few moments, turn the valves until the kerosene slowly trickles into the fire pans.

7. As heat develops and the volume of smoke lessens, gradually increase the oil flow. If it is increased too rapidly, imperfect combustion will result, and the flues and fireboxes will be clogged with soot. Any soot forming in the fireboxes should be raked out. As the muffle begins to grow red, as seen through the spy hole, the smoke should disappear. Experiment with the draughts and fuel supply until the maximum flame that is clean and steady is found.

8. In biscuit firing, especially with heavier pieces, the kiln should be heated at first very gradually to drive out all remaining moisture in the ware. Glazed ware may be brought to the maximum heat more rapidly, but the life of the kiln will be greater if it is applied gradually in the early stages.

9. As the oil pressure slackens when the tanks empty, maintain the oil flow by slightly opening the valves. When the oil pressure increases upon the refilling of the tanks, close the valves a little if necessary.

10. Look at the cones from time to time through the spy hole as the kiln approaches a bright red. When the first cone bends, prepare to hold the fire at the required heat for some time to allow it to soak through the ware. This is especially important with heavy biscuit. When the ware has received a sufficient soaking, and the point of the cone indicating the desired heat touches the support, shut off the oil flow. Close the dampers so the kiln will cool slowly.

11. Record the amount of fuel used, time, condition of cones, weather, etc., in the kiln log.

12. Let the kiln cool without opening until the next morning or until the ware can be *drawn* or removed without gloves.

13. Thoroughly clean the flues and fire pans.

d) Coal, Coke, or Wood

1. Pack the kiln (Figs. 122 and 123) with ware, using saggers if there is no muffle (Operation 33).

2. Wall up the hatch with firebrick laid in sand, or use whatever method of closing the opening the type of kiln provides.

3. Build a slow fire in the firebox. Biscuit firing should be done very gradually so that all steam and gases will be expelled and warping will be prevented.

4. After a few hours, depending on the size of the kiln, thickness of the ware, etc., gradually increase the fire. Close the firebox door to increase the draft.

5. Rake the ashes out from time to time, if necessary.

6. When the oven shows red through the spy hole, continue increasing to a full fire. Be careful not to allow the fire to slacken through inattention. Control the draft with the dampers and by closing the ashpit opening if necessary. Do not let too much heat escape through the stack.

7. Look at the cones from time to time through the spy hole as the kiln approaches a bright red. Quit firing when the point of the cone indicating the desired heat touches the support. Partially close the dampers and keep the firebox door and the ashpit opening closed.

8. Let the kiln cool without opening until the ware can be *drawn* or removed without gloves.

GLOSSARY

ALKALINE. Applied to glazes containing alkalies such as borax.
ALUMINA. Aluminum oxide (Al_2O_3). The base of all clays.
APPENDAGE. An added part, such as a handle, a spout, or a leg.

BAT. A flat slab of plaster or fired clay. Sometimes applied to a lump of moist clay.
BISCUIT. Ware which has been fired once but not glazed.
BISQUE. Same as biscuit.
BLOCK. A master mold, made from the original pattern, in which *cases* are made.
BLOWING. The bursting of ware in a too rapid biscuit fire due to steam.
BODY. The inner essential part of the ware apart from any covering slip, glaze, or decoration.
BUNG. A stack of filled saggers in a kiln.

CALCIUM CHLORIDE ($CaCl_2$). A metallic salt used in clay slip to keep the particles in suspension.
CASE. A reproduced plaster pattern cast in the original master mold or *block*.
CASTING. Making pottery with clay slip in plaster molds.
CERAMICS OR KERAMICS. The art of producing clay products. A general term covering all branches of the industry.
CHINA. An indefinite term, usually meaning porcelain.
CRACKLE. A term applied to *crazing* when produced intentionally for decorative purposes, as the fine network of minute cracks in the glaze of Satsuma ware.
CRAZING. Very fine cracks which appear in a glaze due to its not "fitting" the body; that is, unequal shrinkage of glaze and body. It is also caused by over- or underfiring.

DRAWING. Taking ware out of a kiln after firing.

EMBOSSING. Decorating with raised figures or ornaments.
ENGOBE. A slip coat or thin layer of slip over an inferior body to improve its appearance.

FAT. Very plastic or sticky as applied to clays.
FETTLE. To scrape off mold lines on cast or pressed ware.
FIGURE. A modeled likeness of any object.
FORM. A wood, metal, pasteboard, or linoleum enclosure in which plaster is poured over a pattern to make a mold.
FRITTED. Applied to a glaze containing one or more ingredients which required

fritting to render them insoluble in water. Glaze particles must be suspended but not dissolved in water.

FRITTING. Rendering a soluble substance insoluble by melting, suddenly cooling in water, and pulverizing.

GLOSS. Applied to a glaze with a shiny glossy surface.

GLOST. Glazed ware being fired.

GREEN. Applied to unfired clay.

HARD. Infusible, refractory.

JIGGER. A term applied variously (1) to a machine with a vertical spindle bearing a mold for making flatware, or (2) to a similar machine for making either flatware or hollow ware, or (3) only to the arm and profile of such a machine.

JOGGLE. A joint consisting of a projection and a hole into which it fits, to prevent slipping.

JOLLEY. A term applied somewhat loosely (1) to a machine with a vertical spindle bearing a mold for making hollow ware, or (2) to the arm and profile of such a machine, or (3) to the part carrying the mold, or (4) to a machine with a vertical profile carrier as distinguished from one with a lever arm.

KILN (pronounced *kill*). A furnace or oven for burning or baking clay ware.

LEAD. Applied to soft earthenware glazes containing some form of lead.

LONG. Very plastic.

MAJOLICA. Applied to colored opaque glazed earthenware or to the glaze itself.

MATT. Applied to a glaze whose gloss has been killed by the addition of a sufficient amount of some refractory material, such as alumina, or silica.

MOLD. A plaster form in which clay ware is cast or pressed.

MUFFLE. The fire-clay compartment in a kiln which holds the ware and excludes the flames.

PASTE. Artificially compounded clay.

PATTERN. The original, made of clay, plaster, or other material, around which a plaster mold is poured.

PIN MARKS. Marks left on the base of pottery pieces by supports used in the glost firing.

PLASTIC. Impressionable.

PRESSING. Forming ware on a jigger or hand molding with plastic clay.

PROJECT. A plan or course of action to pursue in making something. Sometimes applied to an object being made.

PROPS. Kiln shelf supports.

PUGGING. Putting soft fire clay between saggers to keep out the fire and gases when packing a kiln. Also, wedging clay in a pug mill.

RAW. Applied to a glaze in which all ingredients are originally insoluble in water, none requiring fritting. *See* fritted.

REFRACTORY. Hard to melt or soften — infusible.

RETURN. A part of the surface of a shape which is at an angle to the main part.
RIB. A small piece of bone, slate, metal, or wood used in shaping or smoothing up ware on a potter's wheel. Sometimes applied to a jigger profile.
RICH. Applied to long or fusible clays.
RIGGET. The groove in a squeeze mold for the excess clay.

SADDLES. Fire-clay rods for supporting glazed ware during the fire.
SAGGER. A fire-clay box in which ware is enclosed in a kiln having no muffle.
SALT. Sodium chloride (NaCl). Used to glaze brick, tile, and other coarse ware. It is thrown directly into the firebox and carried to the white hot ware in the flames.
SHAPE. A piece of pottery, finished or during the process of making.
SHORT. Not very plastic.
SILICA. Silicon oxide (SiO_2). An important ingredient of clay, sand, or quartz.
SLIP. Clay diluted with water to a fluid state for casting, slip painting, or for use as an engobe.
SMOKING. The first stage of biscuit firing during which all water is expelled from the green ware.
SOFT. Applied to glaze or clay which is fusible at comparatively low heats.
SPURS. Small fire-clay supports for glazed pieces during the fire.
STANNIFEROUS. Applied to a white opaque glaze containing tin.
STILTS. A common form of fire-clay supports for glazed ware in the kiln.
SUCKING. Absorbing glaze from the ware in the kiln by saggers, the muffle, or other ware placed too near.

TEMPLATE. A profile pattern.
THROWING. Forming ware on the potter's wheel.
TURNING. Finishing green ware by cutting or shaving and polishing with a tool on the lathe or potter's wheel.

WEDGING. Cutting, slapping, pounding, kneading, or treading clay.
WHIRLER. A small revolving stand used in decorating, banding, etc.

BIBLIOGRAPHY

Barber, Edwin A., *Pottery and Porcelain in the United States* (New York: Putnam Co.).

Binns, Chas. F., *Clay Technology* (New York: Van Nostrand Co.).

——— *The Potter's Craft* (New York: Van Nostrand Co.).

Cox, George J., *Pottery for Artists, Craftsmen, and Teachers* (New York: The Macmillan Co.).

De Sager, W. A., *Making Pottery* (London, England: The Studio Publications).

Fairie, James R., *Notes on Pottery Clays* (London: Scott Publishing Co.).

Gall, I. M. and Van Etta, E. M., *The Art of Pottery* (Milwaukee: The Bruce Publishing Co.).

Harrison, H. S., *Pots and Pans* (New York: William Morrow & Co.).

Janvier, C. A., *Practical Keramics for Students* (New York: Henry Holt & Co.).

Langeback, Karl, *The Chemistry of Pottery* (Easton, Pa.: Chemical Publishing Co.).

Lunn, Dora, *Pottery in the Making* (London: The Dryad Press).

Lunn, Richard, *Pottery* (London: Chapman & Hall).

Marryat, Joseph, *History of Pottery and Porcelain* (London: Murray Publishing Co.)

Noke, Chas. J. and Plant, Harold J., *Pottery* (London: Sir Isaac Pitman & Sons).

Orton, Edward, Jr., *The Properties and Uses of Pyrometric Cones* (Columbus, Ohio).

Reis, Heinrich, *Clays, Occurrences, Properties, and Uses* (New York: Wiley Publishing Co.).

Sandeman, E. A., *Notes on the Manufacture of Earthenware* (London: Virtue Publishing Co.).

Searle, Alfred B., *Clay, and What We Get from It* (New York: The Macmillan Co.).

Sparks, John C. and Gandy, Walter, *Potters, Their Arts and Crafts* (New York: Thos. Whittaker).

Varnum, Wm. H., *Industrial Arts Design* (Peoria, Ill.: Manual Arts Press).

Webb, Judson T., *Pottery Making* (Chicago: Judson T. Webb).

Wren, Henry and Denise, *Handcraft Pottery* (London: Sir Isaac Pitman & Sons).

"The Art Out of Chaos," *The Book of Popular Science,* Vol. 9.

"Ceramics," *The Encyclopedia Britannica,* Vol. 5.

"Pottery," *The Encyclopedia Americana,* Vol. 22.

"Pottery," *The New Practical Reference Library,* Vol. 4.

"Pottery," *The New International Encyclopedia,* Vol. 19.

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